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Universal Design Practices:

Development of Accessible Cellular Phones

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What is Universal Design?

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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

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How practice Universal Design?

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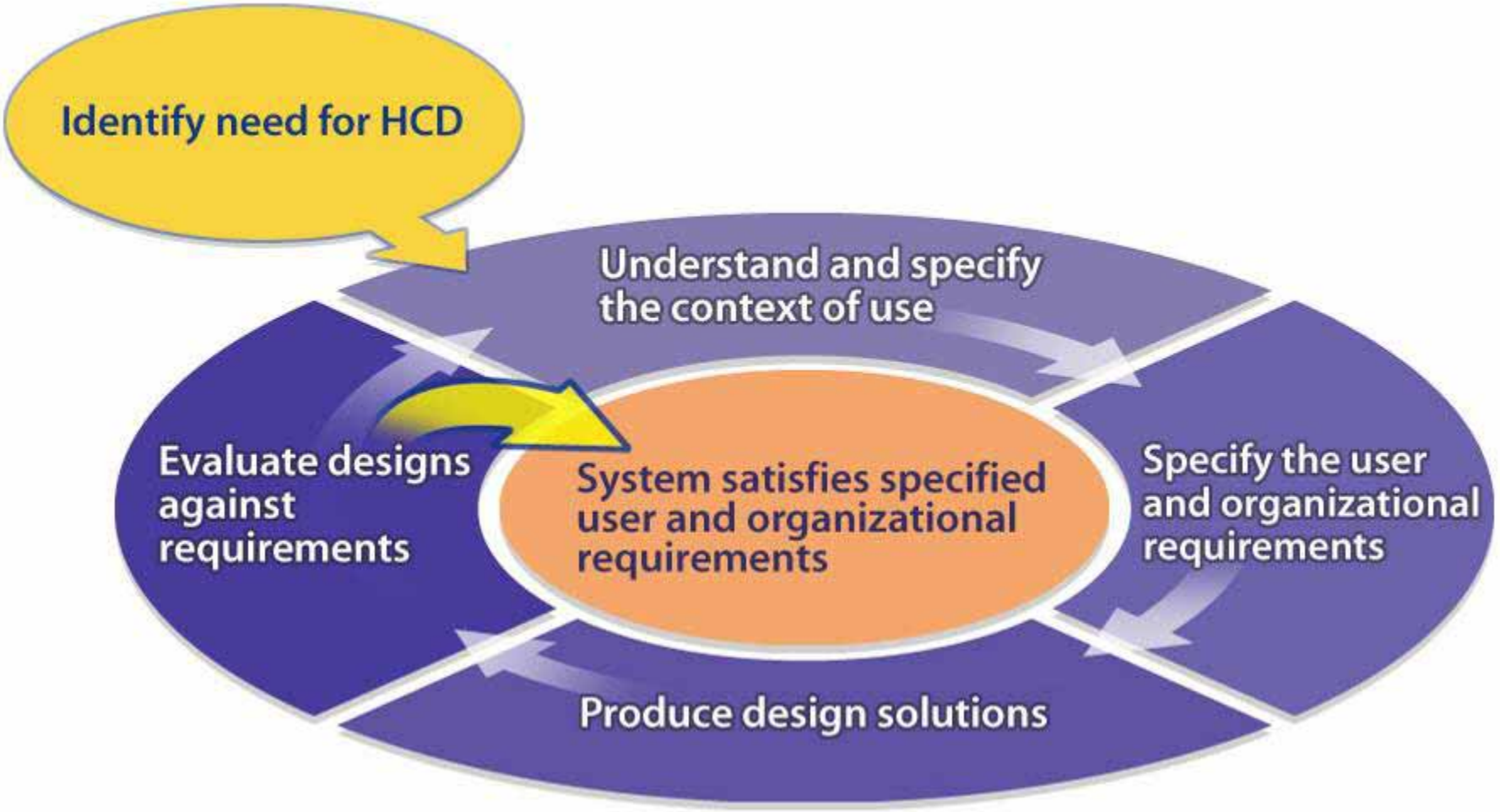
- **Human Centered Design processes**

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



Human Centered Design

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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

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Practical Design Processes

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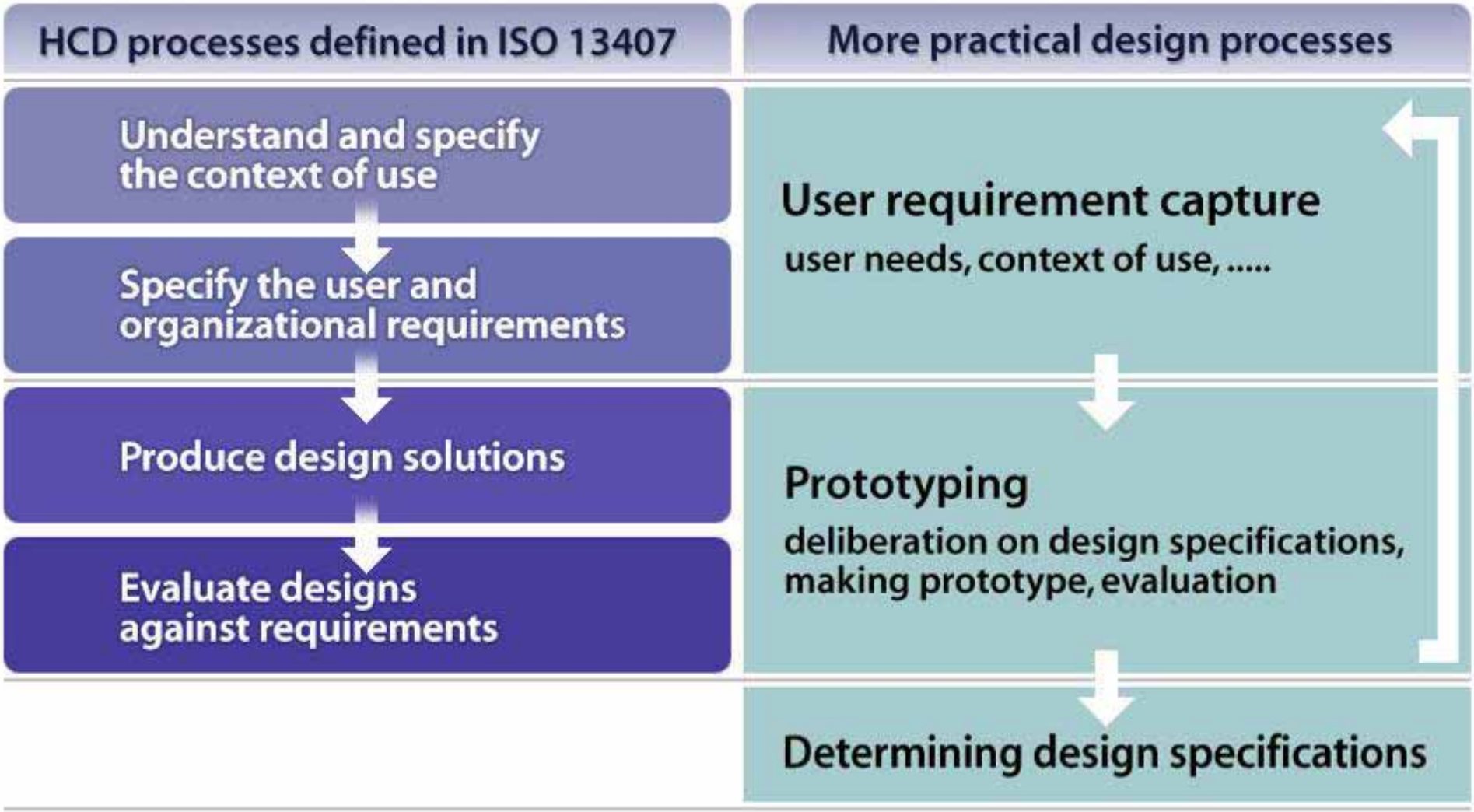

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Case Example: Cellular Phone

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- **Rapid penetration of cellular phones**
  - Japan 85 million (as of October, 2004)
  - USA 172 million (as of November, 2004)
  - Brazil 4.4 milion in 1977 to 35 million by 2002
- **Enhanced functions**
  - SMS, E-mail, Web (Interne 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

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Overview of Accessibility Study

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Processes	General Study	Product Specific Study
User requirement capture	**Phase I** Requirement capture	
	Phase II Hardware issues	
	Phase III Software issues	
Prototyping		Ten-keypad design Audio Guidance
Determining design specifications		
Product		VM4050 (SPRINT)

User requirement capture
(Phase I study)

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- 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
- .....

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User requirement capture
(Phase II study)

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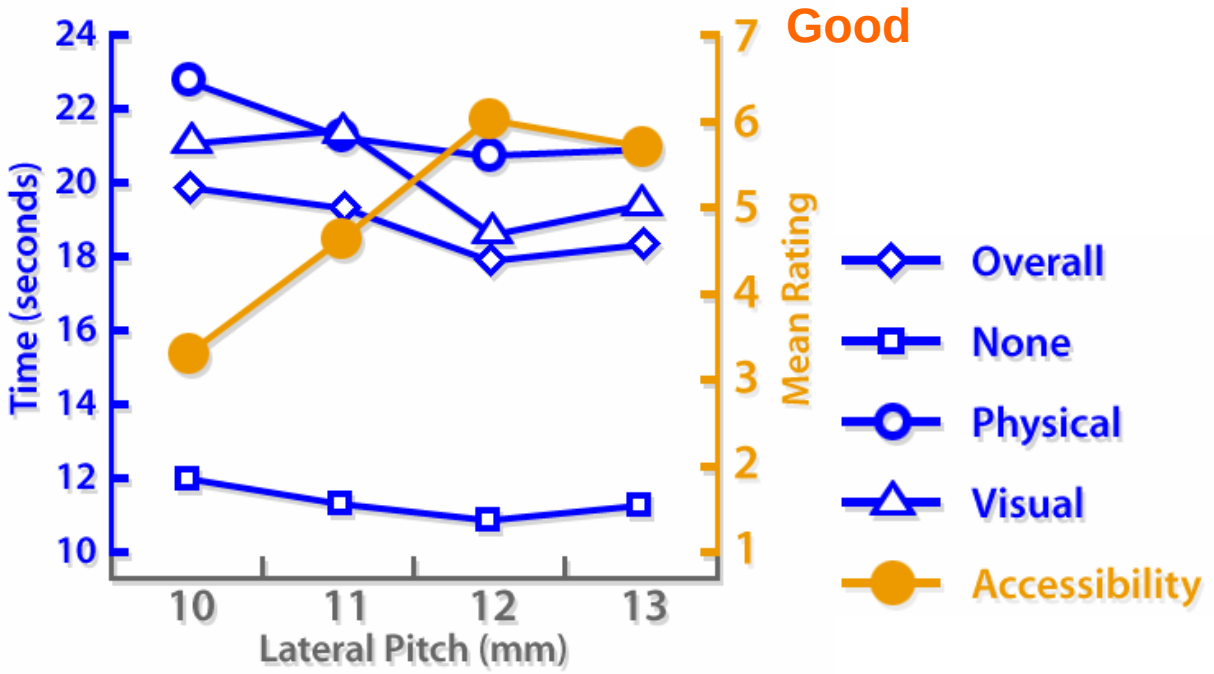
- Experiment to capture user requirements for keypad design
  - **Methods**
    - Performance testing using low-fi mockups

mockups



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User requirement capture
(Phase III study)

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- 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)

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Prototyping
(Product specific study)

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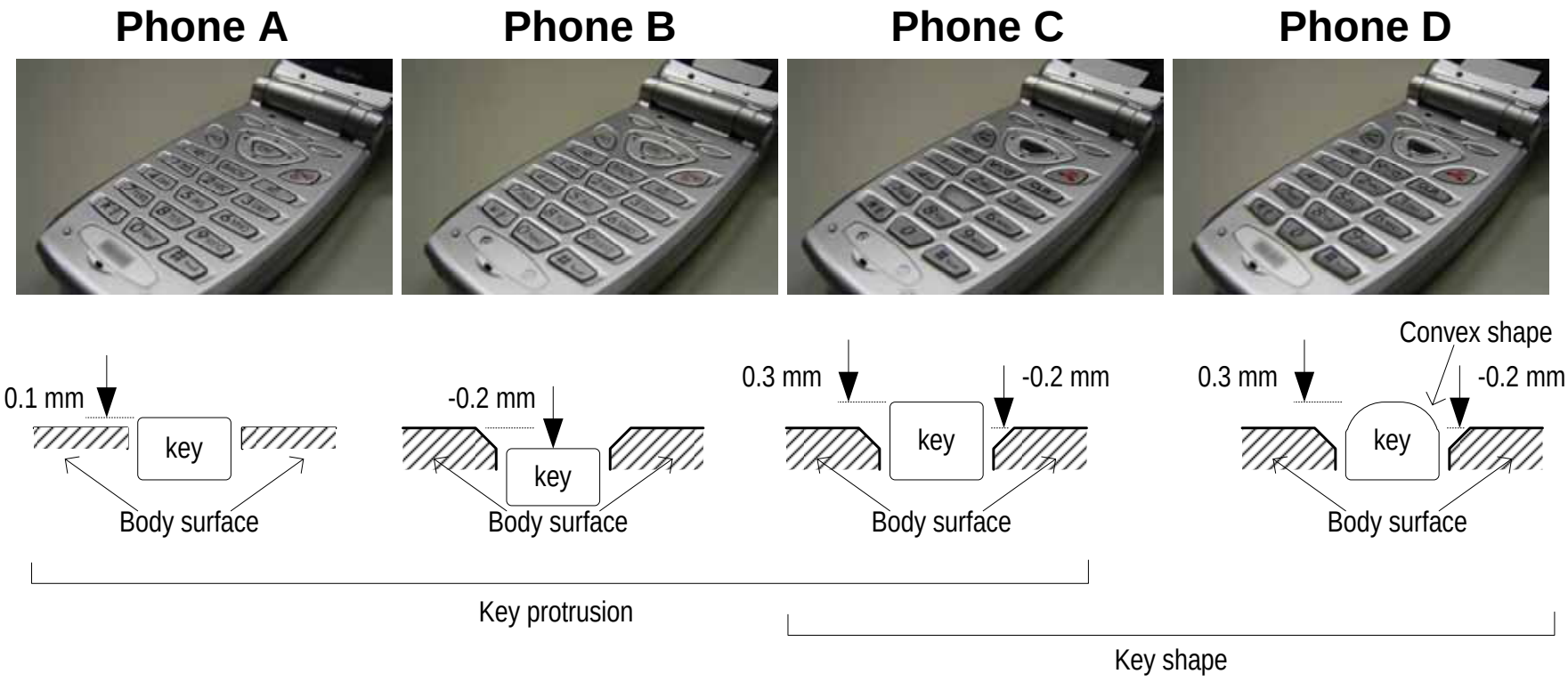
- Determining design specification of keypad
  - **Methods**
    - Product Interactive Focus Group



Product Interactive Focus Group

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Prototyping
(Product specific study)

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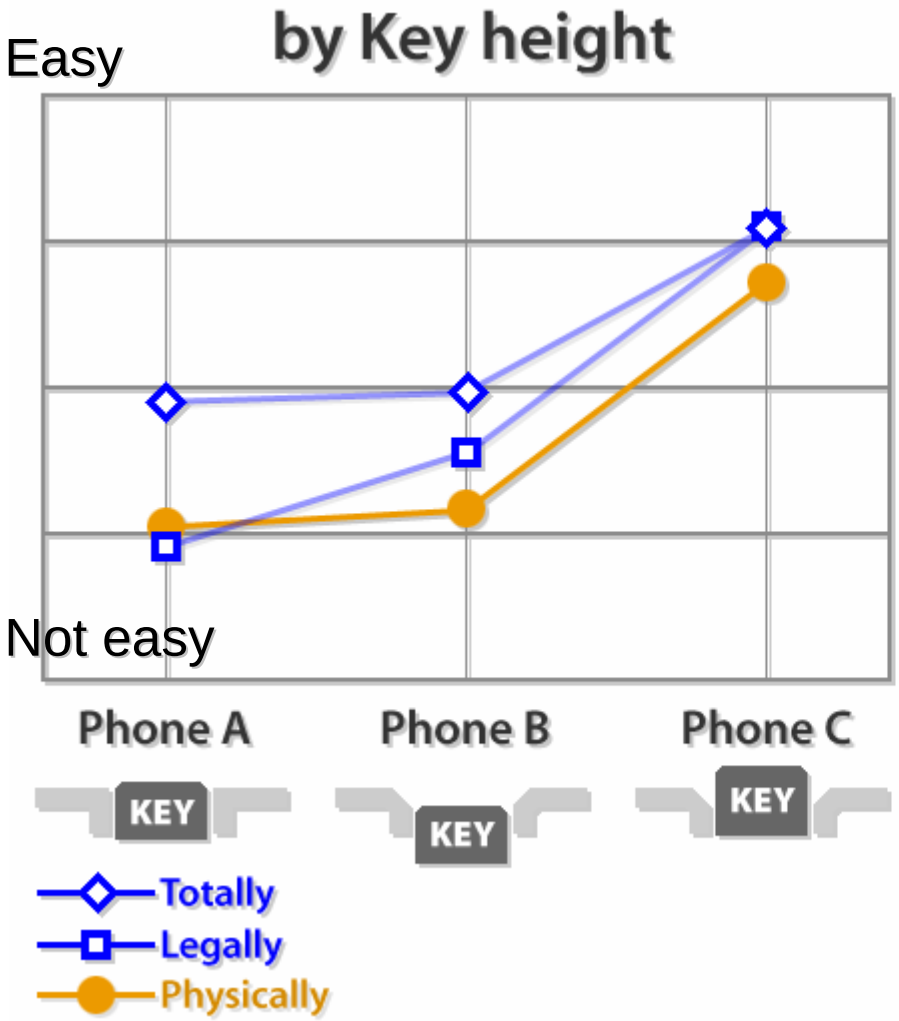
- Mean ratings of "Ease of identifying the keys"



Prototyping
(Product specific study)

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- 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)

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Prototyping
(Product specific study)

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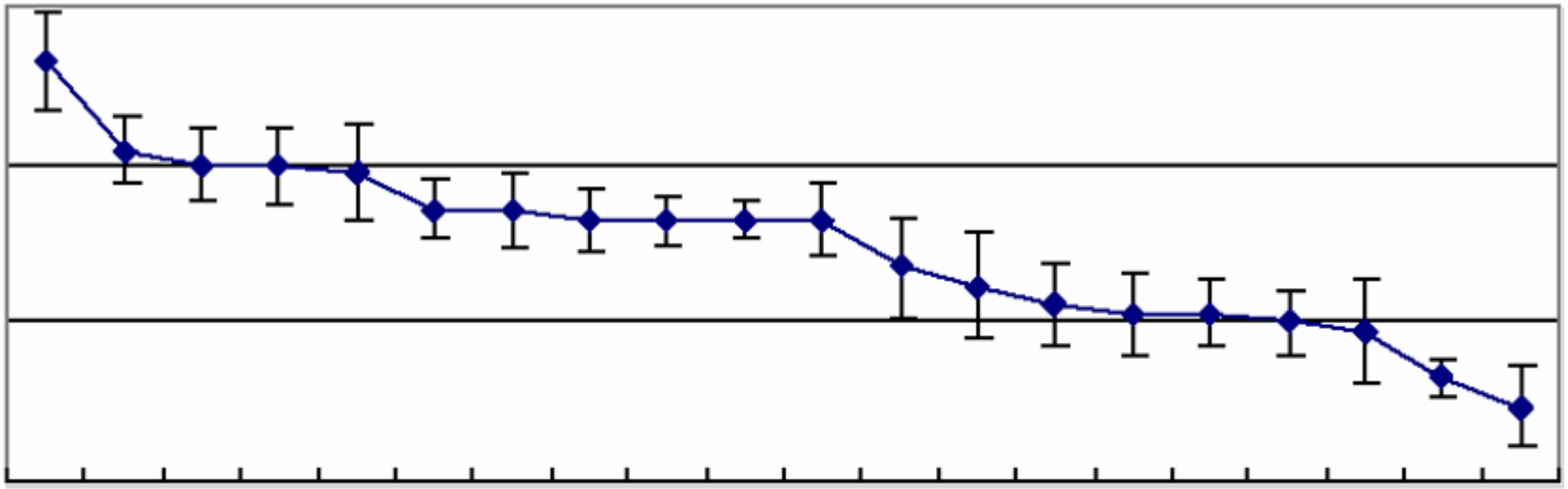
- Mean ratings of necessity of audio feedback (Overall)

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)

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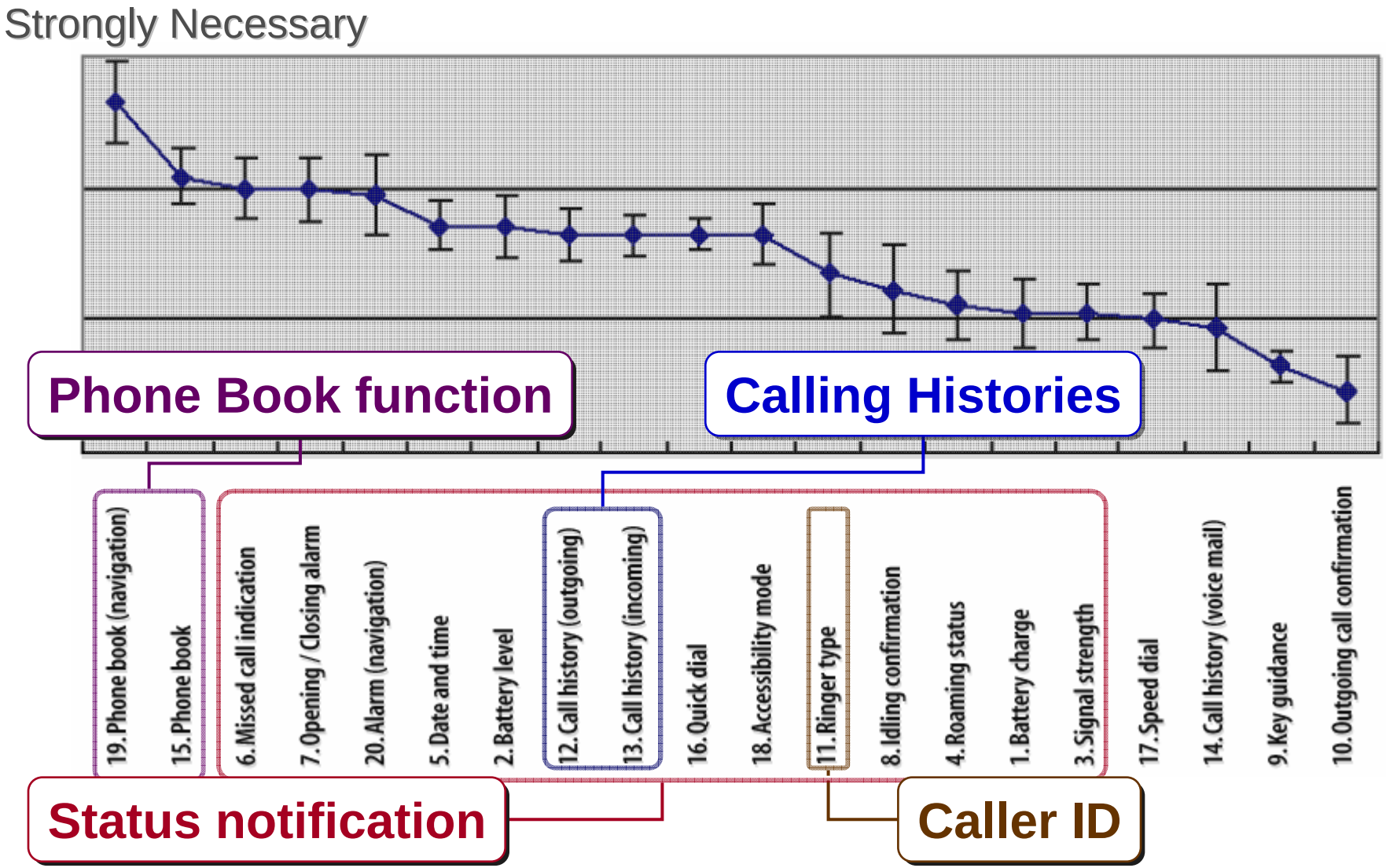
- Mean ratings of necessity of audio feedback (Overall)



Product

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- Actual product (Sprint VM4050 by Toshiba)

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Assessment

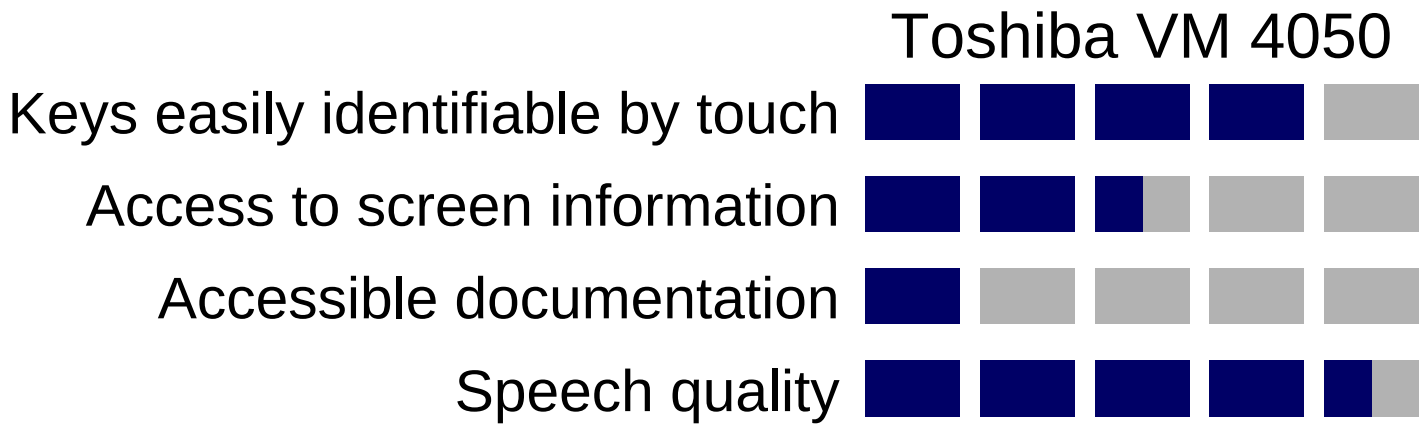
"it is certainly the most accessible phone that can be purchased off the shelf." *(Access world Vol 5, 4, 2004 May)*

- **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.



Conclusion

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HCD Processes	Development Processes for VM4050
Understand and specify the context of use	Phase I: Requirement capture
Specify the user and organizational requirements	Phase II: Hardware issues; Phase III: Software issues
Produce design solutions	Ten-keypad design; Audio Guidance
Evaluate designs against requirements	VM4050 (SPRINT)

Conclusion

- **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.**