LG 2000 Cellular Phone

Ergonomic Evaluation and Recommendations

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Introduction

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Purpose

This paper applies ergonomic principles and methodologies to a study of the design and use of an existing product, the LG 2000 Fido cellular telephone. The purpose is to determine what, if any, recommendations can be made to the physical design of the device in order to better fit its intended users.

Measurements are taken of the device and then compared with existing anthropometric data tables, as well as an analysis of the various functions and tasks the phone and its users perform.

Terminology

Device	The LG 2000 phone
User	Target user group as specified in User Profile:
	Suggested Target Group
Open	The flipped open, or active, state of the device
Closed	The closed, or passive, state of the device



Current Design

Device Dimension Sketches





Task Description

Significant User Tasks

While the device can perform a number of functions it is found that many use the device to complete primary tasks like checking the time, the current communication status and voicemail messages. Other tasks include placing and receiving calls and sending and receiving text messages.

Task Summary

Task*	Issues	Notes
Storing device	Possibly in pocket and bulky	Lower priority
Grab device	Few or none	
Open device	Too small to hold securely; positioning thumb between groove of clamshell difficult and increases chance of dropping; requires significant range of thumb motion	Thumb can coordinate with fingers to pry open clamshell
Dial voicemail	Requires keying '#' (pound) key to confirm PIN: position of key puts thumb at extreme of range of motion and precarious grip for hand on device	High priority
Talk on device	Must rotate arm and exert force to position and hold device near ear and mouth and compensate for shorter length of elbow-ear than elbow to phone grip;	Medium priority
Key buttons	Buttons smaller than thumb breadth; lowest positioned buttons on keypad near bottom of device, puts strain on thumb and hand grip	Low & High Priority

+ All tasks are evaluated based on one-handed use of the device.



Relevant Body Dimensions

Overview

Device Dimension	Static/Dynamic	Relevant Body Dimensions
Open circumference	Static	Grip circumference, hand length, hand breadth
Closed circumference	Static	Grip circumference, hand length, hand breadth
Open length	Static	Hand length, hand breadth, ear-mouth distance, elbow-ear distance
Keypad	Dynamic	Thumb breadth, thumb grip point, hand length, hand breadth, thumb range of motion
Keypad buttons (individual)	Static	Thumb breadth, thumb strength

+ All dimensions in millimetres and rounded to nearest whole digit.



Relevant Body Dimensions

Hand Width and Length

The measurement is relevant in determining how the user holds the device for use, including when it is open and closed. The width can dictate the smallest or largest object the user's hand can accommodate. If the device is too wide or too narrow it will be cumbersome, or unusable.



Grip Width & Circumference

Again, this measurement is relevant in determining not only the maximum or minimum size of device the user's hand can grip, but at what size does the user have the most power, control and comfort.

Elbow-Fingertip Distance

Because many of the device's functions dictate holding it to the ear and mouth, the user's forearm length can determine the angle the device is held at, the relative strain on the user's elbow joints, and the amount of power and stamina required to position the device to complete a task like placing or receiving calls.





Relevant Body Dimensions

Thumb Width and Grip Point

Larger thumb widths can often cause difficulty when dexterity and precision is required with small controls or keypads, such as the compact buttons of the device. The grip point, at which the thumb can exert the most control and power, also relates to the pressure required to active a button and the point at which activation or gripping becomes problematic.

Thumb Reach Envelope

The range in which the thumb can move while gripping the device greatly determines the level of usability presented by control positioning on the device.









User Profile

Current Target Group

The device is distributed in Canada exclusively through Fido Solutions Inc. and thus with a primary user base in Fido's cell phone user market: British Columbia, Canada.

Taking into account the device's marketing, geographic penetration and current design, the following specific profiles are estimated as LG and Fido's target market for the device:



- Age Range
 13-60 years old
- Gender
 Male and female
- Ethnic / Cultural Background
 Inclusive, though primarily English-speaking
- Size

Various adolescent to adult to elderly. Body types ecto- to mesoto endomorph. Excludes infants and children, the physically disabled (blind or missing limbs/digits).

Economic Standing

Lower-middle class (the device is relatively lower-priced) to middle class.

Geographic Location

Urban dwellers in large city centres (based on marketing campaigns, majority Fido customer base, device aesthetics).



User Profile

Suggested Target Group / Population Percentage

Because of the wide range of hand sizes and levels of dexterity found within the current target group, three user profile variations—and thus three device variations—are recommended over providing one device design that meets the needs of only the average or 50th percentile user and thus a small percentage of the target population.



Except for age and gender, the following profiles assume the same demographics as the current target group:

- User Profile A
 13-18-year-old females
- User Profile B

13-18-year-old males 18-55-year-old females

User Profile C

18-55-year-old males In the interest of brevity and focus, only this target group will be addressed in this paper.

User Profile D

55-80-year-old males



Anthropometric Table

Overview

Relevant anthropometric data tables for all four user profiles should be consulted within a complete undertaking of the device's ergonomic redesign. Below, male-only population data is considered. This table is relevant because it is relatively recent (1989) and it considers Americans, a user group very similar in body dimensions to Canadians.

Dimension*	5 th %tile	50 th %tile	95 th %tile	SD	Relevance
Grip circumference	199	214	230	9.7	How far the hand can extend around the device.
Hand length	178	194	210	9.8	The min. or max length the device can be usably held.
Hand breadth, metacarpal	84	90	98	4.2	How the device is cradled and manipulated in the palm. Because thumb is used for keying, full hand width is not calculated.
Thumb breadth, interphalangeal	22	24	27	1.4	Manipulation of keypad buttons.
Elbow-ear distance**	533	561	590	-	Distance to position earpiece to ear. The larger the dimension the more the shoulder joint must be rotated and energy exerted.
Thumb grip point	86	99	109	-	The optimum point on the thumb for keying buttons on the device.
Elbow-fingertip distance	448	484	524	23.3	Related to elbow-ear distance, determines the reach needed to position device earpiece to ear as well as energy applied to hold device a comfortable distance from face.

Body Dimensions of U.S. Civilian Adults, 1989 (excerpt, males only)

+ All dimensions in millimetres and rounded to nearest whole digit.

++ Calculated by equating ear height to eye height and subtracting from this the elbow height. Both units measured from floor in standing position.

Source: The Anatomical and Mechanical Structure of the Human Body, page 27. Adapted from US Army data reported by Gordon, et. al. (1989).



Clothing Considerations

Handwear

Glove and other clothing worn on the hand have a significant effect on the usability of the device. However, the user profile suggests the urban dweller with a majority living in Canada's most temperate climate in Vancouver, where gloves are worn less than other target groups.

Torso and Legwear

Long sleeves on jackets or shirts, and small pockets on pants , have a bearing on the ergonomics of the device. For example, long sleeves could inhibit handling the device; small or nonexistent pockets would limit or determine the usable storage options for the user.

Based on demonstrations and observations of use (users tend not to exhibit a need for a device compatible with interfering wear) clothing is not considered a significant factor in this paper.



Recommended Dimensions

(For User Profile C)

Device Measure	Current Dimension	Current Percentile	Recommend Dimension	Percentile Accomm.	Justification
Width	35mm	5th-95th	60mm	5th-95th	Same percentile range, but with greater comfort and control.
Length open+	175mm	5th-95th	225mm	5th-95th	Same percentile range, but with greater comfort and less exertion to hold it there; closer relationship between earpiece-microphone distance and ear-mouth distance.
Individual numeric keypad buttons	50mm ²	5th-95th	100mm ²	5th-95th	Same percentile, but with more precision, control and comfort.
Overall keypad dimensions	39x35mm	~50th-95th	55x25mm	5th-95th	Accommodates the greater range of thumb motion laterally than vertically; greater comfort; improved one-hand use.
Keypad location from bottom	7mm	5th-95th	125mm	5th-95th	Better accommodates limited thumb extension; better grip on phone when keying bottom buttons

 \clubsuit Does not include antenna



New Design

