Minimize negative impact of vehicles — 0 (Zero-nize)
Maximize comfort and fun (Maxi-mize)
Toyota’s Vision for Vehicle Development

Environment

Zero-nize

Universal Design

Maxi-mize

Safety

Comfort/Fun

Toyota undertakes challenges for Universal Design as a part of “maxi-mize comfort/fun” activities.

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1. Development of Universal Design Evaluation Indices

2. Spiral-up of Development Based on User Interaction
1. Development of Universal Design Evaluation Indices

2. Spiral-up of Development Based on User Interaction
Two Challenges for Universal Design

Our desire is to make various users enjoy their car life comfortably (ergonomics index) in various scenes (situational suitability).

Universal Design Activities

- Human characteristics study
  - Analysis of functional changes (Necessary demand)

- Identification of users needs (expectation/desire)

Index I: Ergo-index

- Improvement of ergonomics performance
  - Adaptable for different body sizes and physical capabilities

Index II: Situational Suitability – Index (SSI)

- Fulfillment of “user needs” through interactive development

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1. Improvement of usability by considering different body sizes and physical capabilities

**Index I: Ergo-index**
- From the viewpoint of ergonomics (Functional, physical aspect of people)

2. Fulfillment of user needs toward cars (usage scenes/situations)

**Index II: Situational Suitability – Index (SSI)**
- From the viewpoint of dialog with users (Mental satisfaction aspect of people)
Universal Design Evaluation Index I

1. Improvement of usability by considering different body sizes and physical capabilities

Index I: Ergo-index

Evaluation method

- Set 180 evaluation items that we should secure performance, through the analysis of human motion & behaviors in vehicle. These 180 items are evaluated by “human characteristic base criteria” and are given score.
- The score of 180 items are summarized with 6 major axis and used for target setting, competitor analysis and so on.

1. Interior configuration
2. Ease of ingress and egress
3. Posture, comfort
4. Field of view, maneuverability
5. Visibility of Meter, indicators
6. Instrument panel, switches/buttons

* Ergo-index
Toyo's original word made by combining the words “Ergonomics” and “Index”
Evaluation Items on Ergo-index

2. Ease of ingress and egress

Front seat/rear seat

- Legs: Ease of lifting, reaching and passing through
- Waist: Ease of sitting down and standing up
- Head/shoulders: Ease of ingress & egress, etc.

5. Visibility of meter, indicators, etc.

Reading meters, indicators, etc.

- Easy to drop eye line onto meter, main indicators.
- Ease of reading letters, indications and symbols, etc. (Considering various conditions; direct sunlight, clear weather, twilight time, at night)
Calculation Method on Ergo-index

(Case: Ease of ingress and egress)

1. Rating each item on a scale of 1 to 5.

2. Weighting

3. Multiplication

4. Calculating index score, after conversion on a scale of 100 points for the full (5 points per item)

<table>
<thead>
<tr>
<th>Points</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Tolerance for error</td>
</tr>
<tr>
<td>3</td>
<td>Low physical effort</td>
</tr>
<tr>
<td>2</td>
<td>Easy to understand</td>
</tr>
<tr>
<td>1</td>
<td>Perceptual Comfort</td>
</tr>
</tbody>
</table>

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Calculation Method on Ergo-index

(Case: Ease of ingress and egress)

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</tr>
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The most appropriate height with little burden added is found.

Average of N=10 (20s – 60s)

- Inside of thigh (Knee-bending)
- Outside of thigh (Knee-bending)
- Outside of lower leg (Lifting heels)
Evaluation Based on Human Characteristics Study

Case: Ease of ingress and egress

... Evaluation of ease of shifting gravity point

Relationship between hip point height and burden on muscles

Evaluation points:
5: Much ease
4: Ease of sitting down
3: Ease of sitting down without effort
2: Feeling of burden
1: Feeling of heavy burden
Evaluation Based on Human Characteristics Study

Case: Visibility of indicators, etc.

... Evaluation of ease of reading letters/display

Relationship between visual acuity and ages

<table>
<thead>
<tr>
<th>Age groups</th>
<th>Under 40</th>
<th>40s &amp; 50s</th>
<th>60s</th>
<th>70s &amp; over</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 cm visual acuity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Visual distance to indicators/instrument panel)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 m visual acuity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Evaluation score (depending on visual acuity levels):

- 3
- 4
- 5

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Index I: Ergo-index

Quantitative evaluation of “how a wide range of users can enjoy driving easily and comfortably” from the viewpoint of ergonomics.

When the product attains the target “ease & comfort to drive” level, label the Universal Design symbol on the product. In addition, indicate the achievement level by the number of the symbols.
Universal Design Evaluation Indices

1. Improvement of usability by considering different body sizes and physical capabilities
   **Index I: Ergo-index**
   ☐ From the viewpoint of ergonomics (Functional, physical aspect of people)

2. Fulfillment of user needs toward cars (usage scenes/situations)
   **Index II: Situational Suitability – Index (SSI)**
   ☐ From the viewpoint of user needs in actual life scenes (Mental satisfaction aspect of people)
**Universal Design Evaluation Index**

**Situational suitability DB**

- **Usage scenes /situations database** (Approx. 500 items)
- **New scene items**
- **Scene choice by vehicle model** (30 items)
- **Planning/ improvement of corresponding items**
- **In-house Evaluation / User evaluation**
- **Spiral-up development**

- **Consecutive addition**

**Decide at the first stage of planning**
## Database Example of Usage Scenes/ Situations

<table>
<thead>
<tr>
<th>Categories</th>
<th>Scenes</th>
<th>Concrete situations for evaluating conformity level of the vehicle model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shopping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driving</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Major scene categories:**
- Trip
- Shopping
- Transfer
- Driving to/from the office
- Driving, etc.
### Calculation method on Situational Suitability Index

<table>
<thead>
<tr>
<th>Categories</th>
<th>Usage scenes corresponding to user needs</th>
<th>Conformity level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shopping</td>
<td></td>
<td>☐ 5</td>
</tr>
<tr>
<td>Transfer</td>
<td></td>
<td>☐ 4</td>
</tr>
<tr>
<td>Driving</td>
<td></td>
<td>☐ 5</td>
</tr>
</tbody>
</table>

#### Ranking criteria

<table>
<thead>
<tr>
<th>Range</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 - 69</td>
<td>☐</td>
</tr>
<tr>
<td>70 - 79</td>
<td>☑ ☐</td>
</tr>
<tr>
<td>80 &amp; over</td>
<td>☑ ☑ ☐</td>
</tr>
</tbody>
</table>

**New RAUM Situational Suitability level**: 85 points

**Conversion on a scale of 100 points for the full**: 120 points
RAUM: Evaluation Results

<table>
<thead>
<tr>
<th>Index I</th>
<th>Interior configuration</th>
<th>Ease of ingress and egress</th>
<th>Posture, comfort</th>
<th>Field of view, maneuverability</th>
<th>Visibility of meter, indicators</th>
<th>Instrument panel, switches</th>
</tr>
</thead>
</table>

Index II

Situational Suitability - Index

Make the evaluation results public on the homepage.
1. Development of Universal Design Evaluation Indices

2. Spiral-up of Development Based on User Interaction
Flow of Customers’ Voices (in the past)

Customers

Merchantability, quality, market trends
Questionnaire, phone tips, AMLUX, etc.

Verifications of products which are under development

Sales Dept., etc.

Engineers/designers

Problems

• Little pre-evaluation with actual customers before the product launching.
• Little direct interaction between engineers/designers and customers
Spiral-up of Development Based on User Interaction

Step 1:
- Interview research
- Questionnaire research
- In-vehicle dynamic research

Step 2: By using prototypes/mockups

Step 3:

Verification by Ergo-index and SSI.

Commercialization

Engineers/Designers

Users

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Summary

1. Incorporate the Universal Design performance in our vehicle development, by utilizing our original indices.
2. Continuously improve both our products and indices, by incorporating our customers’ voices.
3. Make efforts to reflect our customers’ voices on our activities, and create new value and new items.