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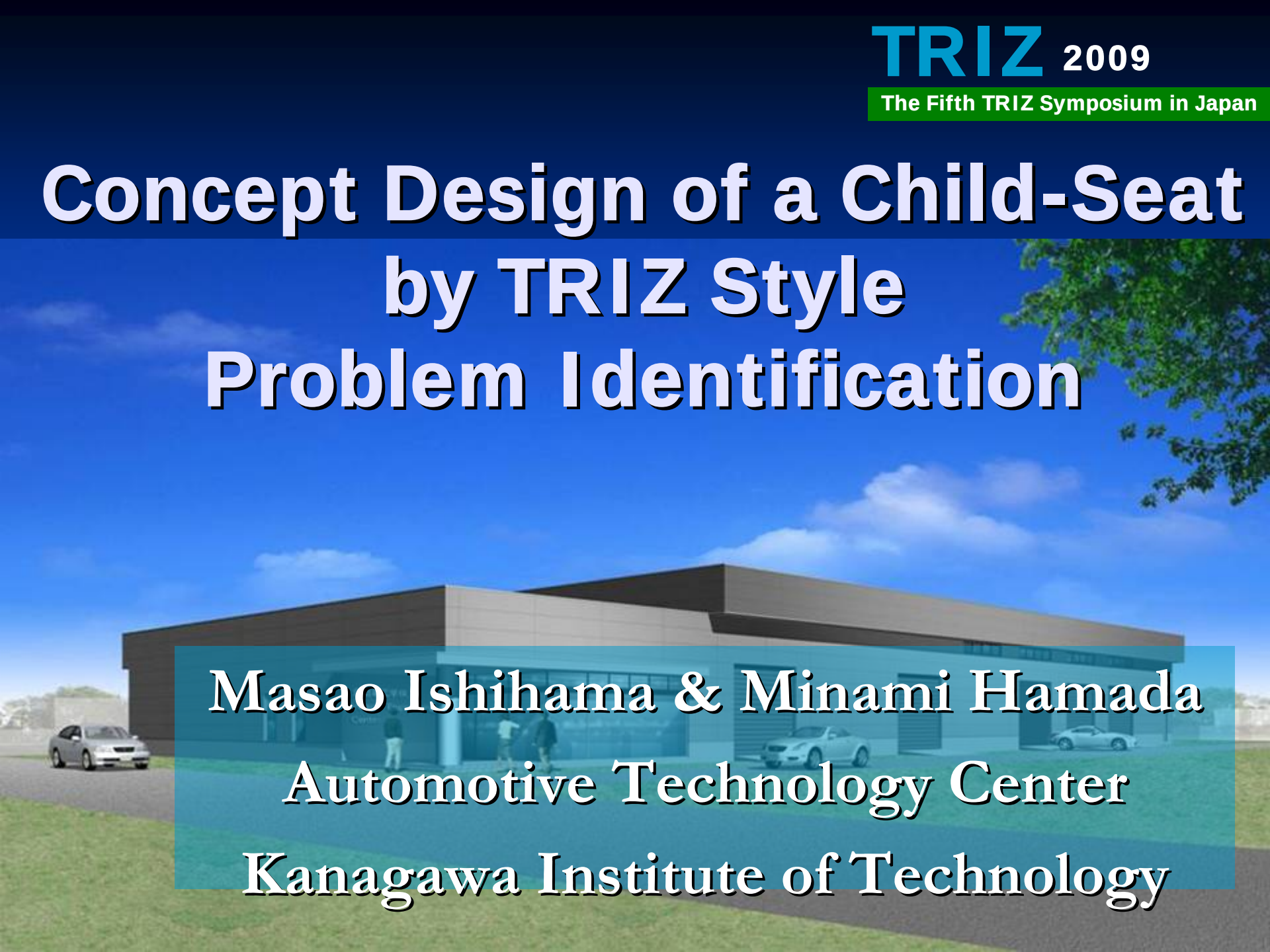
Concept Design of a Child-Seat by TRIZ Style Problem Identification



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1. Background of the Study

- Safety of child-seats for motor vehicles is a matter of national concern.
- Only a few child-seat brands have passed safety regulations set by Japanese government.
- Unsatisfactory practical usability is frequently reported.

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- However, problems to solve were not so clear for the authors to start designing.

2. Defining Our Design Problems

- Problem Formulation of TRIZ style was used.
- Expected functions and unexpected or harmful functions of child-seats were listed.
- Functions are investigated separately according to child-seat using scenes and stakeholders' interests.

Scenes analyzed

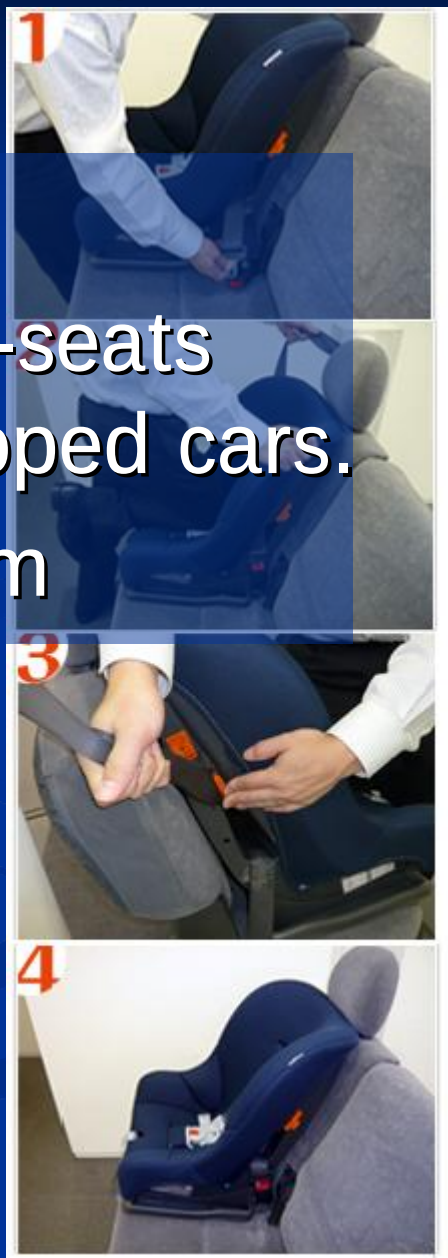
- Installation into a passenger compartment
- Loading and unloading of a child
- Vehicle acceleration and deceleration
- Riding over rough road surfaces
- Eating and drinking
- Playing on the seat
- Collision

Stakeholders considered

- Child
- Parent who care the child
- Driver and the other passengers
- Producer of the child-seat
- Producer of the vehicle
- Government officer

Installation into a passenger compartment

- This work is not frequent.
- Mounting brackets for fitting child-seats became popular in recently developed cars.
- Identified as a less serious problem

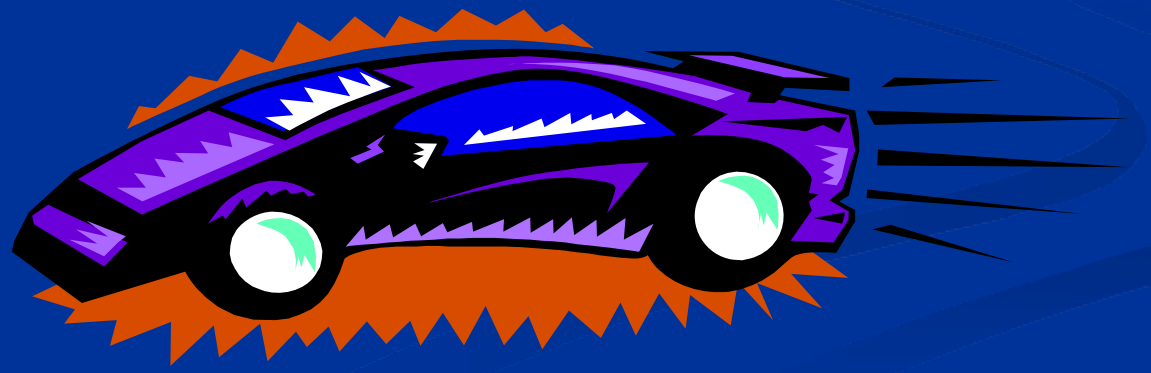


Loading / unloading of a child

- Hard job for parents.
- Side guards block smooth loading & unloading of a child.

Vehicle acceleration and deceleration

- Highly frequent situation.
- Need to protect the child from neck injury.
- Strong influence on ride comfort.
- High seat-back and tight seat strap are conventional unsatisfactory solutions.



Turning corners

- Highly frequent situation.
- Need to protect the child from neck injury.
- Strong influence on ride comfort.
- Side-guard is a conventional unsatisfactory solution.

Riding over rough road surfaces

- Highly frequent situation.
- Need to protect the child from neck injury and motion sickness.
- Strong influence on ride comfort.
- Direct control on vibration insulation and damping is possible by child-seat design.

Eating and drinking

- Help by parent is necessary sometimes.
- Parent’s service is quite awkward due to their restricted body movement.
- Need free torso movement of the child, but restricted by seat straps.

Collision

- Vital function of protecting the child and other passengers.
- Restraining the child's body is necessary avoiding head collision against front seat-back.
- Front, side and rear impact need to be considered.

Defined problems to solve

- Easing the parent's labor in loading/unloading their child.
- Reducing vibration of the child.
- Restraining the child in collision while giving him/her free movement in normal conditions.

3. Resource Analysis

- Around the child seat:

  * Wider space than those for adult passengers.

  * Information on CAN (LAN on a car) that tells potential collision beforehand.

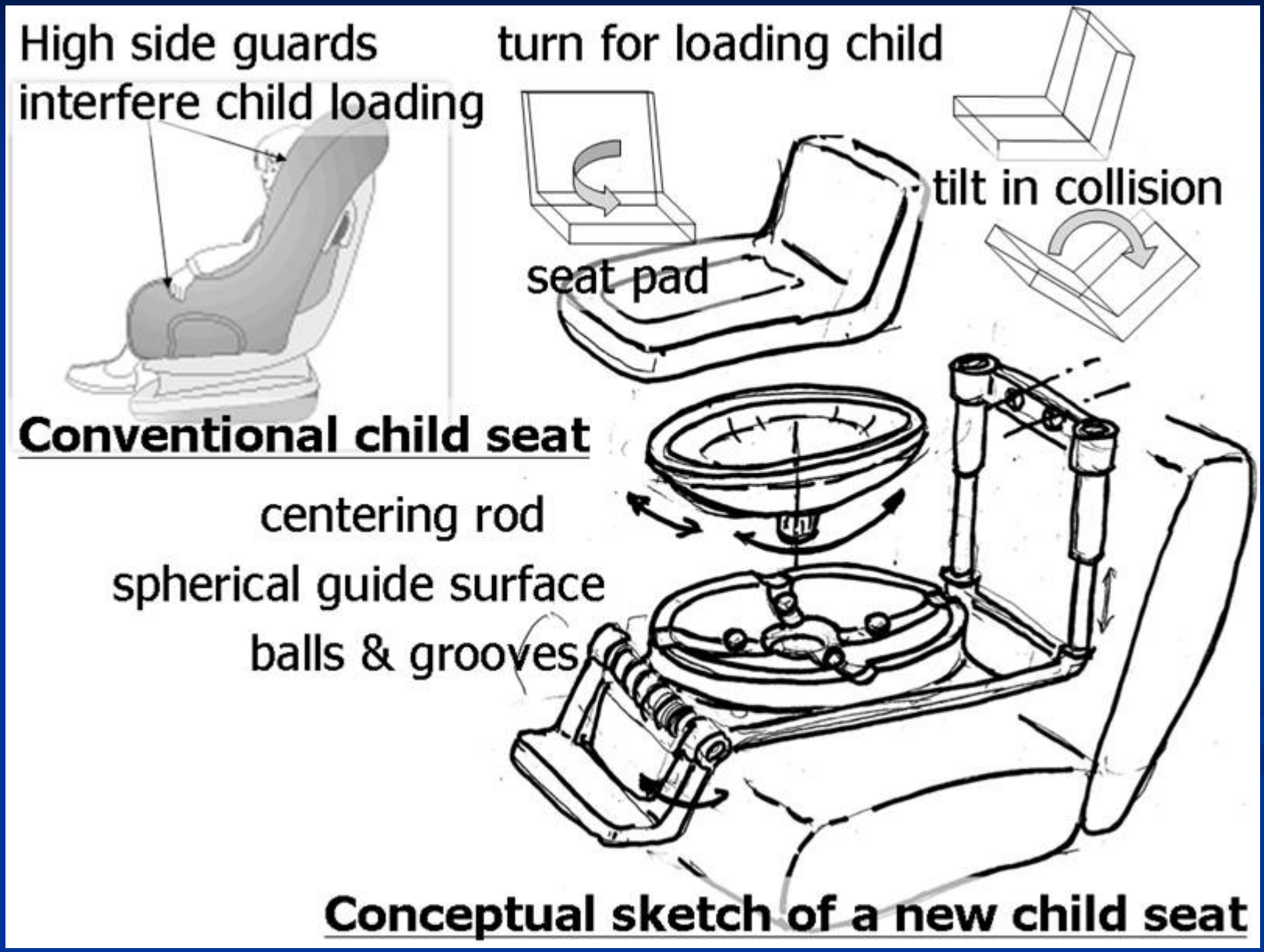
4. Defining Contradictions

- Side-guard function: Between the two movement of the child, such as easy loading vs. constraining lateral movement.
- Between the two functions: Vibration isolation (supporting flexibly) on rough roads and restraining tightly at collision.
- Free movement for eating/drinking and tight restraint at collision.

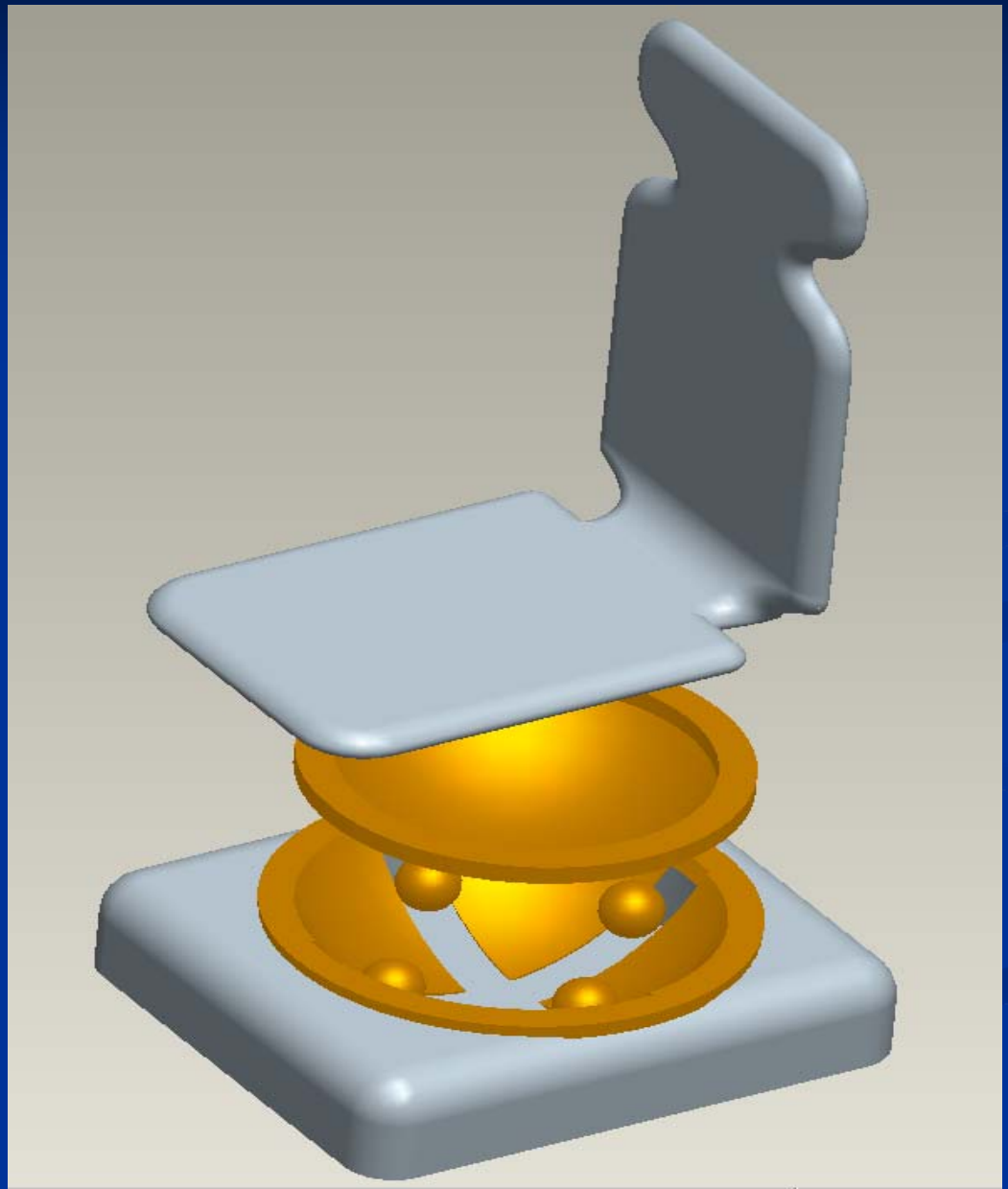
5. Inventive Principles used and Conceptual Design Embodied

- "Segmentation" ⇒ Separating seat and support.
- "Dynamicity" ⇒ 90 degree horizontal seat turn for loading.
- "Spheroidality, Counter-weight & Self-service. ⇒ Swinging motion for vibration absorption and child attitude control
- "Universality" ⇒ Realize the above function by spherical hollow surface for a seat pad..

6. Sketch of the Design -1

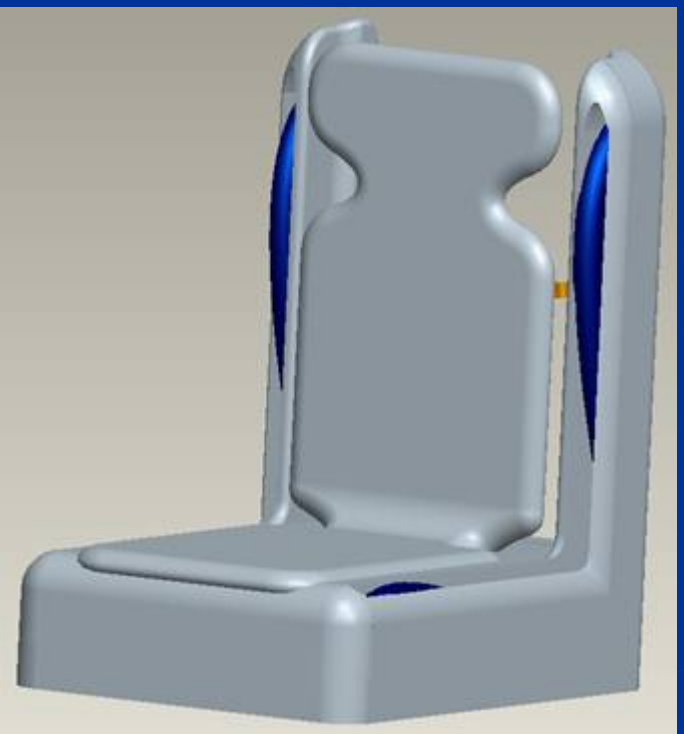


6. Sketch of the Design - 2



Movement in loading / unloading

- Move to other dimensions
- Balancing
- A seesaw and snap action mechanism automatically pushes up or pulls down the side guards by the child's weight.

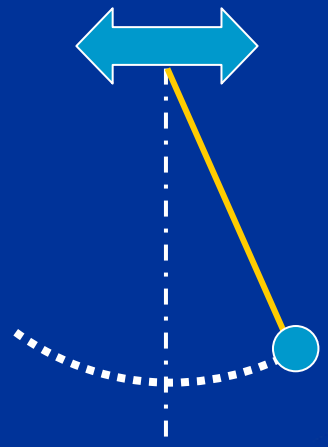


Vibration control action

- Dynamicity
- Mechanical vibration
- Division

Vibration isolation by setting the natural frequency low

Lateral vehicle vibration



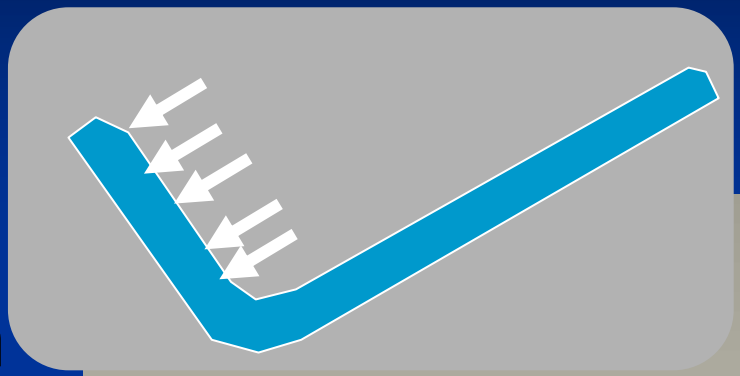
Movement in collision

- Moving to a new dimension.

- Receiving G at collision by the seat pad rather than seat belts.

- Prior action.

- Utilizing deceleration signal from CAN and tightening the belts.



Conclusions

- Conceptual design of a child seat was created that solves vital problems of conventional products.
- The TRIZ function and attribute analysis identified successfully the problems to solve that were hard by conventional methods.
- Resource analysis found the key factors of child seat design.
- These tasks were easily achieved by a graduate student who studied TRIZ just a few weeks.