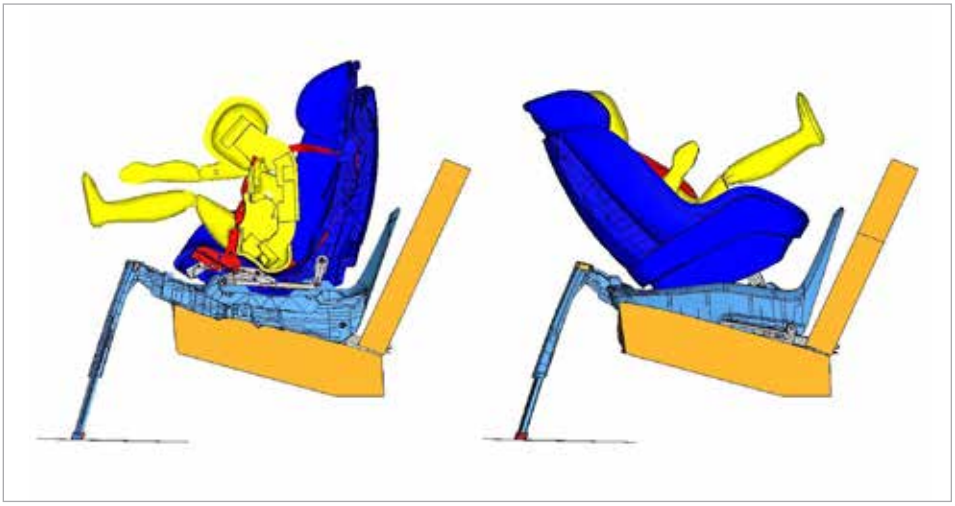
Safety Comes First – Development of a Maxi-Cosi Child Seat Using a CAE-Driven Design Process



Key Highlights

Industry
Engineering Services/Consumer goods

Challenge
Redesign of a two way facing safety child seat with increased loads, reduced packaging space, and according to the new European I-size safety requirements.

Altair Solution
A CAE-driven design process with APA solutions, PBS Works, and HyperWorks tools.

Benefits
- Shorter time to market
- Reduced costs due to less physical testing and prototyping
- First child seat on the market that fulfills all requirements of the new European I-size regulations for child seats

Summary

When developing a new child seat, safety is paramount. Dorel Juvenile, market leader in child safety in cars, was confronted with the task to develop a new child seat - the Maxi-Cosi 2wayPearl. To investigate and analyze the best feasible design, considering the occurring forces during an accident, Dorel Juvenile turned to Code Product Solutions, an engineering service provider that supports their customers in the development and optimization of products, using computer-aided engineering (CAE) tools. Within the development process, Code Product Solutions engineers employed the Altair HyperWorks CAE suite utilizing RADIOSS® for crash simulation, OptiStruct® for the layout of highly loaded plastic parts that comprise the reclining system, HyperMesh® for pre-processing tasks, and HyperCrash® and HyperView® during post-processing.

In addition to HyperWorks, Code Product Solutions uses Altair's PBS Professional™ a workload management tool to efficiently schedule and manage jobs across its high-performance computing (HPC) cluster, MADYMO dummies coupled with RADIOSS and Moldflow for molding simulation. MADYMO dummies from TASS are available as part of the Altair Partner Alliance (APA), a program which provides a broad array of third party solutions via the flexible HyperWorks Unit licensing system at no incremental cost to Altair customers. Using Altair technologies, Code Product Solutions engineers saved their client time and money while fulfilling all design requirements.

Code Product Solutions

For this project, Harold van Aken and his team were responsible for virtual development and crash simulation. Code Product Solutions is an engineering and consulting firm that supports clients in the development and optimization of products using computer-aided-engineering tools, such as Altair's HyperWorks suite. The company's mission is to be a trusted partner to its customers, making product development processes more efficient,

Keywords: HyperMesh, RADIOSS, crash, safely, dummies, MADYMO, APA

Dorel Juvenile Success Story

"We were very satisfied with the final result and the efficiency demonstrated by the project. The design was right the first time, fulfilling all requirements of the new I-size regulations with a cost-effective design, thanks to a significant reduction of physical testing and prototypes. Without a CAE-driven design process, this project would not have been possible. Altair HyperWorks®, in particular HyperMesh®, OptiStruct®, RADIOSS®, and HyperView®, is the standard tool we use in our daily work to support customers like Dorel Juvenile to develop better, more innovative products in a shortened time to market."

Harold van Aken
CEO and Senior Simulation Engineer of Code Product Solutions

helping them save time and money, and improving overall product performance. Engineering services and consultancy is provided to guide relevant development decisions such as the choice of design, materials, and production techniques. While many companies still use simulation late in the development process, when the design is almost final and extensive changes are very expensive, Code Product Solutions employs simulation early, during the conceptual phase, optimizing product design regarding weight and performance before design decisions are made.

This methodology is called CAE-driven design. More information may be found at www.code-ps.com.

The Safety Challenge

The initial goal of the project was the modification of the existing Maxi-Cosi FamilyFix seat base, so that rearward-facing functionality could be added. Many countries have child passenger restraint requirements and laws applying specifically to child seats, which usually vary with respect to age, weight, and height. Often, the regulations are divided in three stages: for newborns and babies, rearward-facing infant seats are used; toddlers are placed in forward-facing child safety seats; and older children use booster seats. The biggest challenges were the increasedloads due to the requested two-way functionality and the reduced and modified packaging space for the seat base. In particular, the more forward position of the support leg required major structural changes. "These engineering challenges were overcome by using our vast experience in design rules for plastic injection molding parts in combination with material selection and numerical analysis using HyperWorks to verify the concepts," said van Aken.

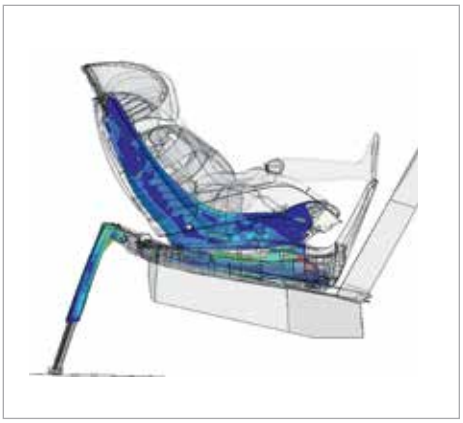
Rearward-facing seats are requested for infants because they reduce the danger of an injury during a frontal crash. Newborns and very young children are not yet able to control their heavy heads without support, especially in case of a crash. When a new European wide standard for child safety seats – the I-size regulation – was introduced over the course of the project, Dorel Juvenile decided that the new seat should adhere to these new requirements. This combination of more desired functionality and additional regulatory requirements substantiated the business case for an almost complete redesign of the seat base.

CAE-driven Design: The Solution to Get it Right the First Time

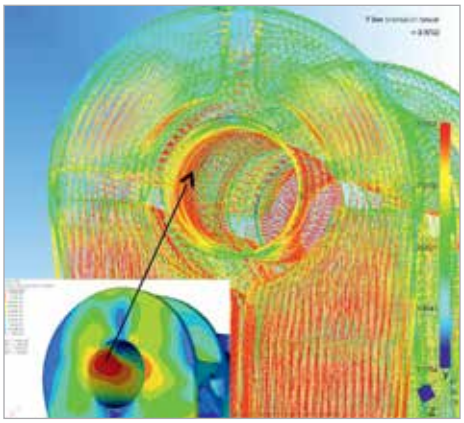
Close cooperation between Dorel Juvenile and Code Product Solutions and the use of a CAE-driven design method made the redesign of the seat base a very efficient development process. Thanks to virtual crash tests with Altair's HyperWorks CAE suite, no physical prototypes or interim testing were required, and engineers got the design right with the first detailed design proposal.

The MaxiCosi 2wayfamily child seat System offers a two-way functionality.

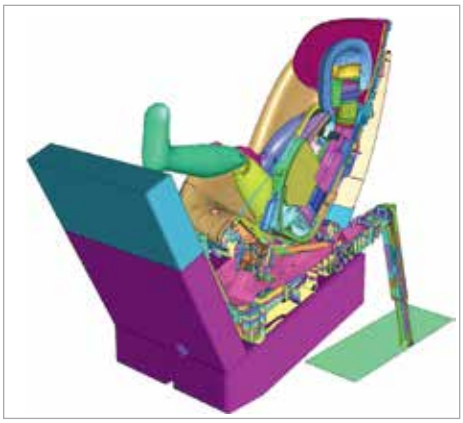
HyperWorks frontal impact simulation, simulation, forward and rearward facing positions.



2wayFix & 2wayPearl. Rearward facing with front impact crash simulation.



Coupled mechanical and injection moulding simulation of the adjustment mechanism.



The new child seat is the first to meet the new European I-size safety requirements.

Peter Stokman, Innovation Manager Technology at Dorel Juvenile confirmed: “The results from Code Product Solutions’ simulations were instrumental in the design of the 2wayPearl.”

"The CAD models were first set up in the CAD system of our costumer and the subsequent meshing was performed with HyperMesh. One of the biggest advantages of HyperMesh in this project was the mid-plane surface meshing capabilities, in particular for the crash models. The crash models were built in RADIOSS, our standard explicit solver for child seat development," explains van Aken. HyperCrash was used to perform model checks, for dummy positioning, and belt routing for the initial model. To fully exploit the engineering capacity for design tasks, Code Product Solutions also used an inhouse developed software that automatically provides a complete set of models to perform simulations for all 12 requested load cases. The engineer only has to import the version of the modules in the seat and the software automatically builds the entire crash model, using the capabilities of RADIOSS.

This software is standard within Code Product Solutions to build advanced and complex crash models when using RADIOSS.

Additionally, automatic report generation in HyperView maximized the time available for value-added engineering on the project to explore more solutions. These detailed PDF reports are automatically produced after the simulations are completed and include quality checks on results, energy levels, section forces, and stress and strain results to rapidly compare design concepts.

Satisfying results and major benefits.

"We were very satisfied with the final result and the efficiency we have reached in this project. The design fulfilled all requirements of the new I-size regulations with a cost effective design for the customer. Bottom line, without a CAE-driven design process, this project would not have been feasible," said van Aken. "In addition to a successfully streamlined CAE process, we could also reduce hardware and software investments by applying PBS Professional. This helped us to maximize the utilization of all our hardware and software assets on our HPC cluster," he added. The redesign tasks were largely driven by material substitutions where plastic was used instead of steel. These changes combined with an expanded number of defined load cases (12 in total) required a much larger number of simulation runs, e.g., to gain insights on the wall thicknesses and rib locations. This in combination with demanding performance requirements all led to a very successful design.

Without CAE tools, the only alternative available to engineers would have been trial and error. This method, however, would probably not have been sufficient to cover all required load cases, or at least not without a tremendous increase of time and money. Thus, the gained insight of simulations was key to the development of the seat.

"Altair HyperWorks, especially HyperMesh, OptiStruct, RADIOSS and HyperView are the standard tools for us in our daily work and help us to support customers like Dorel Juvenile to develop better and more innovative products in a shortened time to market," concludes van Aken.

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About Altair

Altair empowers client innovation and decision-making through technology that optimizes the analysis, management and visualization of business and engineering information. Privately held with more than 2,000 employees, Altair has offices throughout North America, South America, Europe and Asia/Pacific. With a 30-year-plus track record for high-end software and consulting services for engineering, computing and enterprise analytics, Altair consistently delivers a competitive advantage to customers in a broad range of industries. Altair has more than 5,000 corporate clients representing the automotive, aerospace, government and defense, and consumer products verticals. Altair also has a growing client presence in the electronics, architecture engineering and construction, and energy markets.

About Code Product Solutions

Coe Product Solutions is an engineering and consulting firm that supports clients in the development and optimization of products through the use of simulation analysis. Our engineering services and consultancy guide relevant development decisions such as the choice of (structural) design, material and production technique. It is our mission as a reliable and innovative partner to optimise the quality and performance of our customers' products in a more efficient product development process, helping them save time and money.

www.code-ps.com

About Dorel Juvenile Europe

Dorel Juvenile Europe is a world class juvenile products company. Our common goal is to give parents the most advanced products and services. Our well known and very strong brands Maxi-Cosi, Bébé Confort, Quinny, Safety 1st, and Baby Art can be found in no less than 80 countries around the world. We aim to be the market leader in terms of innovation and safety. Dorel Juvenile Europe is ISO 9001 certified.

www.doreleurope.com

Altair

Altair Engineering, Inc., World Headquarters: 1820 E. Big Beaver Rd., Troy, MI 48083-2031 USA
Phone: +1.248.614.2400 • Fax: +1.248.614.2411 • www.altair.com • info@altair.com