

# SUPERHEROES 4 SCIENCE



## VIRTUAL PROTOTYPING

Humanity is unique in its use of such a wide range of materials for building things. No other organism on the planet uses glass, metal, wood, plastics, stone, concrete, and other organic materials all at once.

This ability to use anything around us to build with has allowed us to develop many wondrous modern achievements, such as skyscrapers, bridges, and large sophisticated vehicles like cars, trains, and aeroplanes.

It requires great skill to make things, and there is a well developed process. First, there is a problem, then people must think of ideas to solve the problem. If the solution requires something to be built, then people must figure out if it is possible to build it, and then design it, build it, and finally implement it. There may then be some refinement and development afterwards to address any issues that are discovered, or update the technology as new discoveries are made. Here we will focus on the design stage.

When something is designed, usually experienced engineers use their knowledge of materials and physics to create a design, which is then built, and thoroughly tested.

Within the EU and other nations are laws which ensure things are designed and built in a safe way. For example, toys must not cause injuries, bridges must be strong enough, and in the showcase we present to you, train seats must be safe if there is a crash.

BORCAD cz s.r.o. is a Czech company which designs and manufactures train seats, and has been working with IT4Innovations, the Czech national supercomputing centre, since 2012.

Traditionally a company such as BORCAD would create a design, predict its safety using a combination of experience and complex mathematical models, build a proto-type, and then test the prototype. If the prototype failed the test, then a new design would need to be made and tested. This process would repeat until the prototype passed the safety test.







Because BORCAD designs train seats, they must typically pass two tests; one test ensures the seat can be in a crash and not be destroyed, the other test ensures the person in the seat (represented by a crash test dummy) survives the crash without too much damage (i.e. injury).

This has until now been a time consuming and costly process, requiring the design, construction, and testing of many prototypes before finalising a design.

As computer technology has advanced, scientists like the ones working at IT4Innovations have looked for ways to beneficially apply these developments to all areas of human endeavour. As useful as smartphones are, one of the most important applications has been that of supercomputing in engineering. It is now possible to simulate complex crash tests on supercomputers like those at IT4Innovations (Anselm and Salomon), and some of our team (Prof. Petr Horyl, Dr Pavel Maršálek, Dr Tomáš Karásek and Dr Petr Ferfecki) have been given the HiPEAC Technology Transfer award for research results that are transferred into industrial practice, for their work with companies like BORCAD. The project 'Improved Passive Safety and Comfort of Passengers in Railway Traffic' helped BORCAD virtually safety test their designs, and only when the design passed the virtual safety test simulation was a physical prototype built and tested. The virtually tested prototypes passed the safety tests first time.

This work has allowed BORCAD to more easily enter the international markets of the United Kingdom and North America with the Regio seat and the first class seat for the Canadian Rocky Mountains Scenic Railway, and equips BORCAD with tools to better exploit more international markets in the future.



Supercomputers thusly help science, research, and businesses like yours.

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