

Benefits and advantages of ergonomic studies in digital 3D

Susanne Kiel, Peter van der Meulen
Human Solutions GmbH, Kaiserslautern

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Introduction

Ergonomics is the science or occupation that applies theories, principles, data and methods to product design, with the goal to optimize user comfort, health and safety, as well as overall system performance. RAMSIS provides the infrastructure to effectively and efficiently integrate those theories, principles, data and methods into the design process.

The ergonomic quality of products and cars specifically is becoming a purchase argument for the end-user. In fact, comfort, safety and the possibility to adjust a car to individual needs rank among the five most important purchase arguments for customers. In Europe and the US, it is not uncommon for an employer to pay insurance claims to employees who have been diagnosed with physical problems, due to extensive exposure to bad seated positions in company cars. From an expensive product such as a car, customers demand and are entitled to the highest level of comfort and safety possible. Manufacturers are expected to use state-of-the-art technology to ensure these levels.

Nowadays even specialized magazines dedicate more attention to ergonomics and review cockpit space and user friendliness of control elements in cars. It has become a strategic decision for car manufacturers to make ergonomics an integral part of their design process.

What is RAMSIS?

RAMSIS is a digital human model, a highly efficient CAD tool for occupant simulation and ergonomic design of vehicle interiors. The software provides engineers with a detailed CAD representation of the human body (manikin) that can be animated to simulate driver behavior. It enables the user to perform extensive ergonomic analyses in the early stages of the product development process, using CAD data only, thereby reducing the number of costly design iterations and follow-up improvements at a later time.

RAMSIS was developed in the 1980's by Human Solutions GmbH in Kaiserslautern (Germany). The development of RAMSIS was initiated and funded by the entire German automotive industry. Their goal was to overcome the insufficiency of existing ergonomic tools, e.g. the widely used two dimensional SAE J826 template and to improve ergonomic qualities of vehicles beyond legal requirements. The development of RAMSIS is still heavily supported by the German automotive industry and new developments and functions are in most cases based on input from automotive customers.

RAMSIS has become the automotive industry's de facto standard for ergonomic design. It is used by more than 70% of all vehicle manufacturers worldwide. Customers include e.g. Audi, BMW, Porsche and DaimlerChrysler.

General Benefits of RAMSIS

Process security

Many ergonomic studies are conducted in physical mock-ups or prototypes and with real human test subjects. Physical mock-ups and prototypes can only be built when sufficient design details are available. As a result, user tests often take place at a relatively late stage in the design process. Tooling may have even started already. At this stage of the development process, correcting design problems and making changes to the vehicle will result in significant time delays and increased development costs. Often, it is too late to change the vehicle at all and thus, driver safety and comfort may be compromised. By conducting ergonomic studies and ensuring proper accommodation of the future driver population in the early, digital stage of the development process, the number of costly follow-up design corrections is greatly reduced.

Cost and Time Savings

Building physical mock-ups and using real human subjects for ergonomic testing is extremely expensive and time consuming. RAMSIS requires CAD data only to perform ergonomic studies. While designing a highly complex and regulated product such as a car, the need for physical test will never be completely eliminated, but by conducting many ergonomic studies digitally, the number, extent and costs of physical tests can be reduced significantly.

Increased product quality

With RAMSIS, many ergonomic studies can be conducted with CAD data only. Such digital studies can be conducted faster than physical studies, as they do not require the construction of a mock-up or prototype. However, the overall speed of the design process is not determined by the ergonomics process (only). Thus, RAMSIS allows designer to conduct more ergonomic studies in the same time frame. More design proposals can be evaluated more thoroughly. Among RAMSIS customers, this advantage has resulted in increased product quality and customer satisfaction.

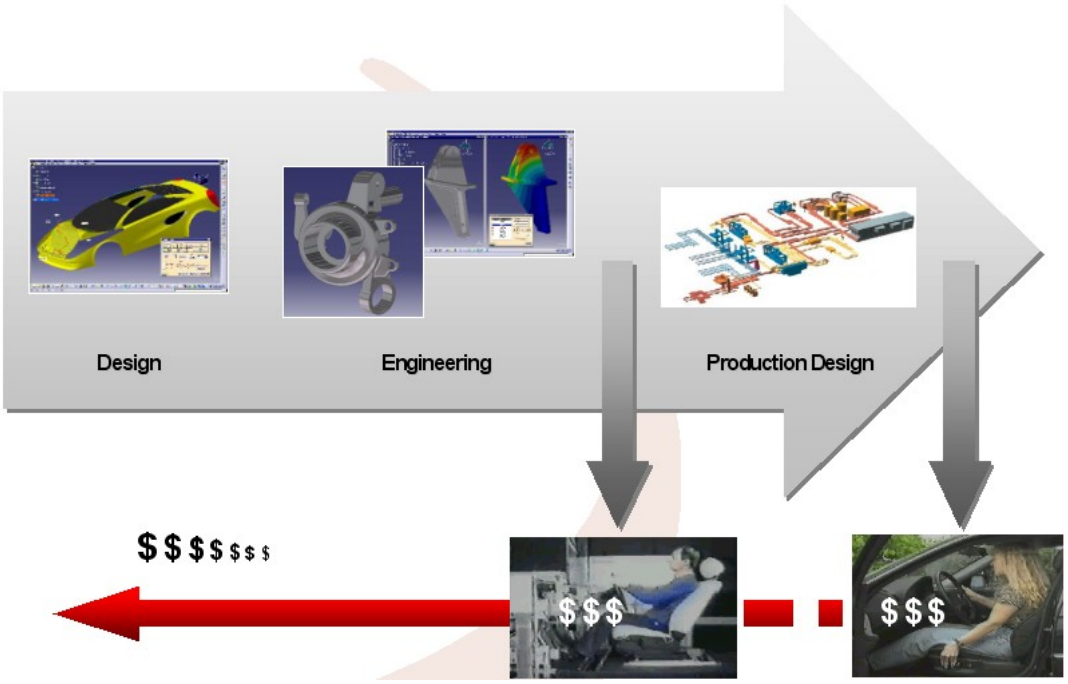

Figure 3.1 The Design Process without RAMSIS

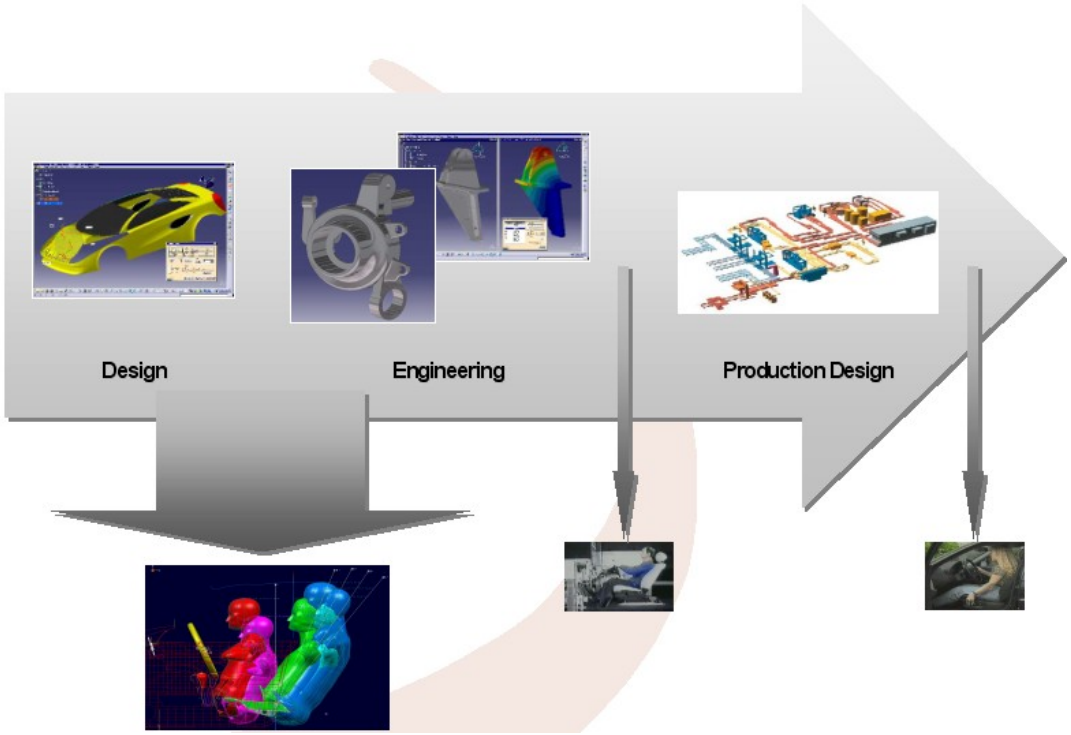

Figure 3.2 The Design Process with RAMSIS

Example Calculation

One major RAMSIS user carried out an example calculation in the past, showing the cost savings that were achieved by applying RAMSIS for ergonomic tests rather than physical mock-ups and real test subjects. For this calculation, a total number of 20 ergonomic experiments per year was assumed, for which 4 physical mock-ups were required. With each mock-up, 5 different experiments were conducted, involving -on average- 20 real test subjects and one employee (usually a trainee). The costs were estimated as follows:

Item	**Costs per year (US $)**
Investment: 4 mock-ups (materials and labor)	320.000
Work: 5 experiments, 20 subjects per experiment	8.700
Employee (trainee)	46.500
Total	**375.200**

The customer then decided to conduct these 20 experiments with RAMSIS. For these 20 studies, one RAMSIS license was required, operated by one trained employee. The license (US$60.000,-) was depreciated in 3 years. Yearly Care and Maintenance costs for one license were US$10.000,-. The costs were estimated as follows:

Item	**Costs per year (US $)**
Investment: 1 RAMSIS license	20.000
Care and Maintenance for RAMSIS	10.000
Employee (trained)	135.000
Total	**165.000**

This calculation provides a good insight in the methods that RAMSIS customers use to justify the investment in RAMSIS and compare costs with other strategies of conducting ergonomic experiments.

Anthropometric Database

Cars are developed for international markets. Thus car manufacturers have to consider different target user populations with different body measurements right from the beginning of the design process. With RAMSIS, it is possible to create different manikins and test populations by adjusting relevant body dimensions.

RAMSIS features one of the most recent databases of the Chinese population. RAMSIS also features databases of Germany, USA, Canada, France, South-America, Japan, Korea and Mexico.

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Figure 5.3 Packaging

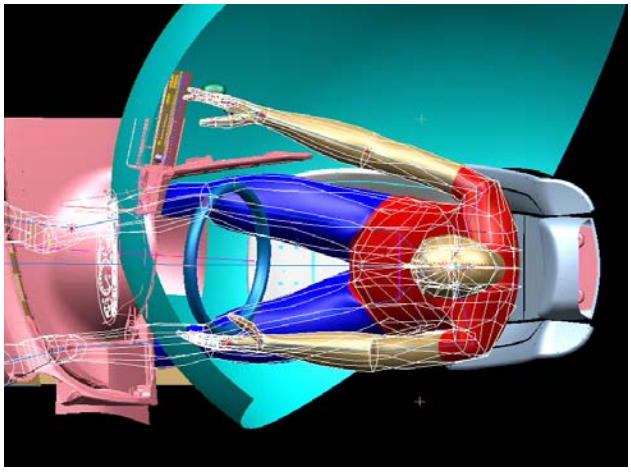

Figure 5.4 Reach Analysis

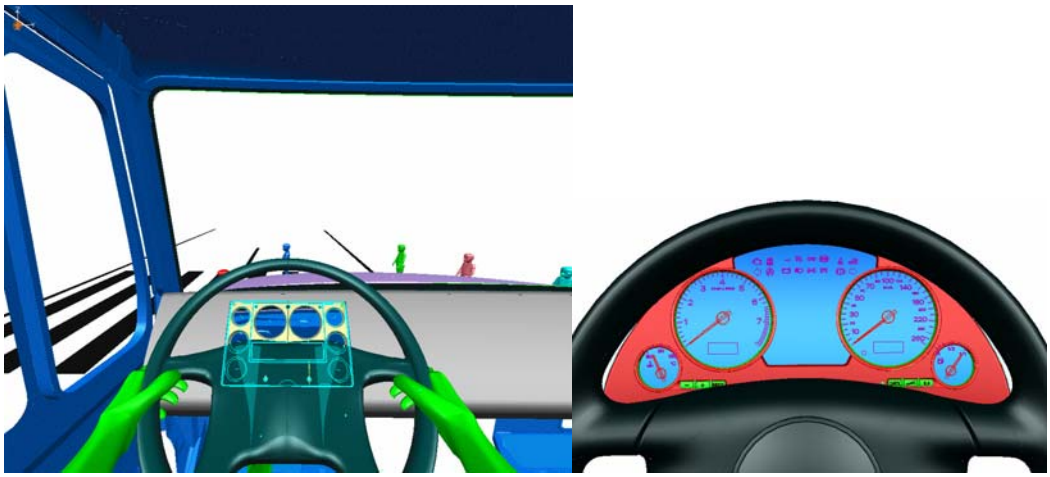

Figure 5.5 Vision Analysis

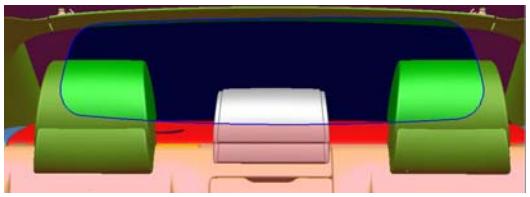

Figure 5.6 Mirror Analysis