Title:
Concept Development of Design Driven Parts Regarding Multidisciplinary Design Optimization

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Introduction:
In order to find the optimal concept for a complex product the expert knowledge of different domains is necessary. Hence, many simulations and analyses are made by different specialists during the development process, based on the CA-data model, which is not meant to be just a virtual embodiment of geometry but a data-pool, too [2]. The designer modifies the virtual model according to the simulation results. This common process contains diverse disadvantages:

- Using different simulation software leads to a loss of information during data exchange.
- Peers analyze the product "only" in regard to their domain.
- Experts working in a multi-project environment have to priorities projects. As problems in the serial development have to be dealt with immediately, the concept phase is often not treated sufficient, although there is the highest potential for cost savings and reducing the development-time.

Main Idea:
For a product development with focus on the Multidisciplinary Design Optimization (MDO) [1] all experts of the different domains have to cooperate in each analysis. To avoid loss of information and rework the analyses-results have to be obtained in a compatible data format to the CA-system.

This work shows, on the example of the headlamp concept development of BMW, how the principle of MDO can be integrated efficient and practice-oriented in the development process. Therefore a Knowledge Based Engineering System (KBES) [3] is created which contains and combines the expert knowledge of different domains. The goal is to provide a construction system that allows one user to handle all the different specialist fields and reduce the amount of possible mistakes as well as the time needed to create and validate different concepts.

As the system is highly specific for one component the different tools can be saved in a prepared status where relevant parameters are published and can be manipulated so that highest flexibility is guaranteed over the whole product-range. The flexibility is also increased by the fact that the KBES allows manually performed changes by reading out the current model each time a macro is started. Simulations are performed automatically by CA-integrated tools using the Application Programming Interface (API) of a modern CA-system. Design processes are also automated to ensure a data quality ready for simulation. The whole construction, as well as the analyses, is controlled by a central Graphical User Interface (GUI). Only the relevant adjustment opportunities are available for an intuitive control.

The User has the opportunity to start different simulation processes to give statements to the current design stage concerning different subjects on his own at any time. The different simulation tools may also be combined and automated for iteration loops in order to find the optimal result for the overall system. Intelligent parts within the component structure contain semantic information which is needed as input for simulation. They also observe the compliance of different constraints during automated or manually performed changes.
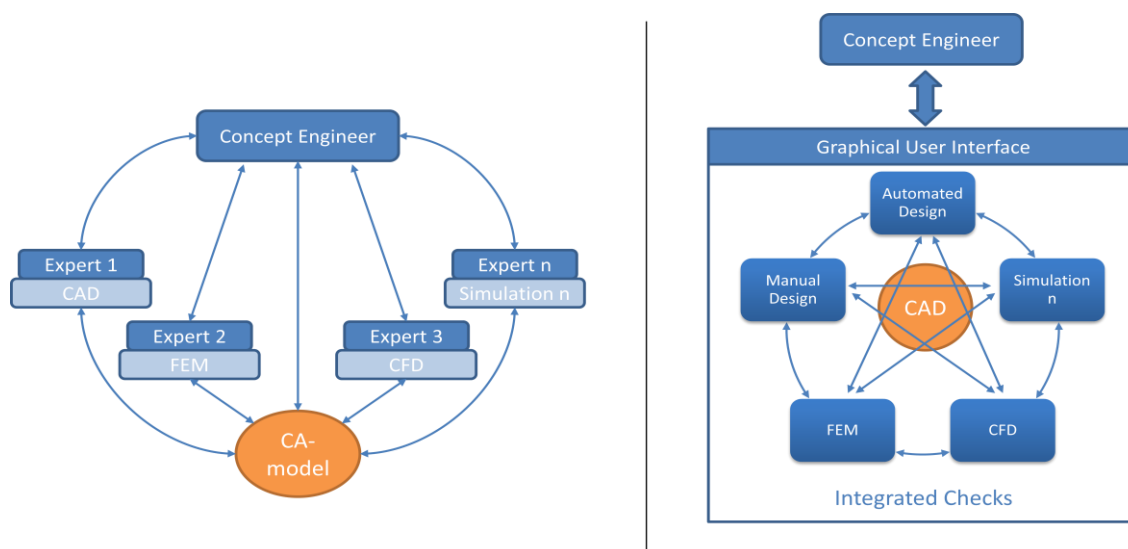
Fig. 1: (a) common process, (b) Knowledge Based Engineering System.

Conclusion:

Researches in the concept development for BMW head lamps show that, with using a KBES, even for time-critical projects, no necessary validation (if integrated into the KBES) is skipped. As there are no waiting times for different experts and the presetation for the component, the system is specialized for, are already present, simulations can be made very fast and with a high degree of automation. Further advantages are the time savings because of design automatization and a consistent design process for all derivates.

The focus in the early development phase is not only creating a geometry describing the installation space and defining the technical concept anymore, but to develop and analyze the complete component before the commissioning of a supplier for the serial development.

References:
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