



# Software independence: impact on product development plan in automotive industries

**M. Annarumma\*, A. Naddeo, M. Pappalardo**

Department of Mechanical Engineering, University of Salerno,  
via Ponte Don Melillo, 84084 Fisciano (SA), Italy

\* Corresponding author: E-mail address: maannarumma@unisa.it

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## Industrial management and organisation

### ABSTRACT

**Purpose:** Purpose of this paper: Actually, in automotive industries one of the most important activities in product design is the evaluation of various events (i.e. crash events) using FEM simulation; in this context, software independence, that means to obtain the same simulation results on the same car-model using different FEM solvers, will be useful for reducing virtual prototyping time and consequently Time To Market.

**Design/methodology/approach:** Development of a software-independence translation method is the aim of this work, which is an input data translation by a methodology independent of the FE calculation environment and allows reducing drastically the product development time. This methodology will be developed writing ad hoc a routine in Matlab language, that carries back in LS-DYNA environment the cards written in RADIOSS environment, helped by TextPad editor and completed by pre-processor Hypermesh.

**Findings:** The translation could be executed using the pre and post-processor Hypermesh and the RADIOSS model card manual correction, but this way to operate increases greatly the Time To Market, although today is the only method used in the most important Italian automotive industry.

**Research limitations/implications:** A Software independence in Virtual Prototyping could help to accelerate several processes. The need to reduce costs and to increase quality is nearly obvious.

**Practical implications:** Most of crash simulation models are developed in RADIOSS environment, but the LS-DYNA environment potentialities exploration has increased the simulations demand using LS-DYNA software; therefore the development of a translation method like that meets this requirement.

**Originality/value:** For product designers, the development of a translation methodology, that allows to carry back in a software environment the Know How developed for another software environment, will be very useful (We've to remind that often many design tasks of a project are made in outsourcing way).

**Keywords:** Production planning and control; Translation routine; Software-independence translation; Product development time

## 1. Introduction

Today, in order to achieve the economic success in the global Market, car manufacturing companies have to be able to identify efficiently the customer needs and to quickly create products that satisfy them and are manufacturable with contained costs.

In order to achieve these aims, only marketing or designing or manufacturing problems haven't to be tackled and resolved: the winning product idea pass through a Product Development Plan,

carried out in effective and efficient way and involving all main business functions [1].

In this context, the reduction in development time hasn't to be considered with aim to itself, because the total profit of designing is the goal of enterprise's management. The competition is won if a customer new need is satisfied and if answer modality is very interesting. The information technologies, that, such as in our case, are able to carry out a "Software independence in Virtual Prototyping", could help to accelerate several processes. The need to reduce costs and to increase quality is nearly obvious, but there

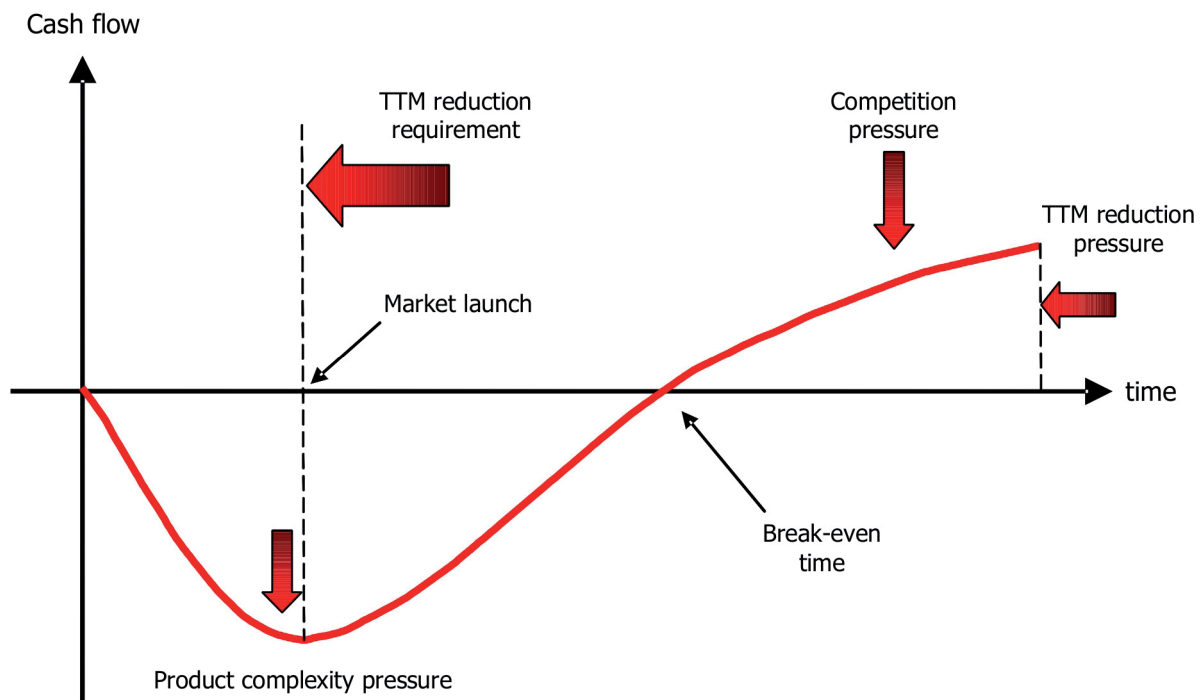


Fig. 1. The competitive and financial incentives to reduction in TTM

are also other reasons that drive to reduce the development time, like the need to bring in Market new products characterized, for example, by an actual style. The way in which the pressures, which the Market does on the car manufacturers, affect the design typical cash flow, has been synthesized in the Figure 1 [2].

In actual business practice, the most used FEM solvers in Automotive industries for crash simulation are RADIOSS, PamCrash and LS-DYNA. Particularly, most of crash simulation models are developed in RADIOSS environment, but the LS-DYNA environment potentialities exploration has increased the simulations demand using LS-DYNA software.

Starting from previous observation, for product designers, the development of a translation methodology, that allows to carry back in a software (LS-DYNA) environment the consolidate Know How developed for another software (RADIOSS) environment, will be very useful (We've to remind that often many design tasks of a project are made in outsourcing way) [3-9].

The translation methodology [10] has been developed writing a routine in Matlab 6.5 language [11], helped by textual editor TextPad and completed by pre-processor Hypermesh 6.0 [12].

### 1.1. Vehicle product development plan

The complete vehicle development process requires a combination of many separate activities, how the Figure 2 shows [13]. These activities are frequently performed in separate departments with little internal communication. Automotive companies are now redesigning their internal processes to coordinate these diverse tasks and provide some logical structure for communication. In addition, a more formal design process is

being implemented to ensure that separate design groups can work on different parts of the development activity in parallel and also ensure that the final combined activity produces a design that meets the performance targets initially set.

Modern vehicle development, in fact, requires a combination of many engineering disciplines. The demands for performance, durability, safety and other customer oriented factors must be combined in a cost effective process to create a new vehicle within a shorter time [14-15].

It is important to note that the new technologies that are being adopted, are changing the commercial and organizational side of the automotive industry. These commercial and organizational changes in turn are driving new technologies in engineering in an effort to "catch-up" with the changes demanded in the market environment. Engineering isn't driving the changes; it's reacting to them.

In this context, the information technologies able to carry out a "Software independence in Virtual Prototyping", become a part of the product development plan, that lies after the virtual model carrying out and before its use for any testing operation.

### 2. Description of the approach to translation methodology

The translation methodology has been developed writing ad hoc a routine in Matlab 6.5 language, that carries back in LS-DYNA environment the main cards written in RADIOSS environment, helped by textual editor TextPad and completed by pre-processor Hypermesh 6.0, which has the user section configurable according to used solver.

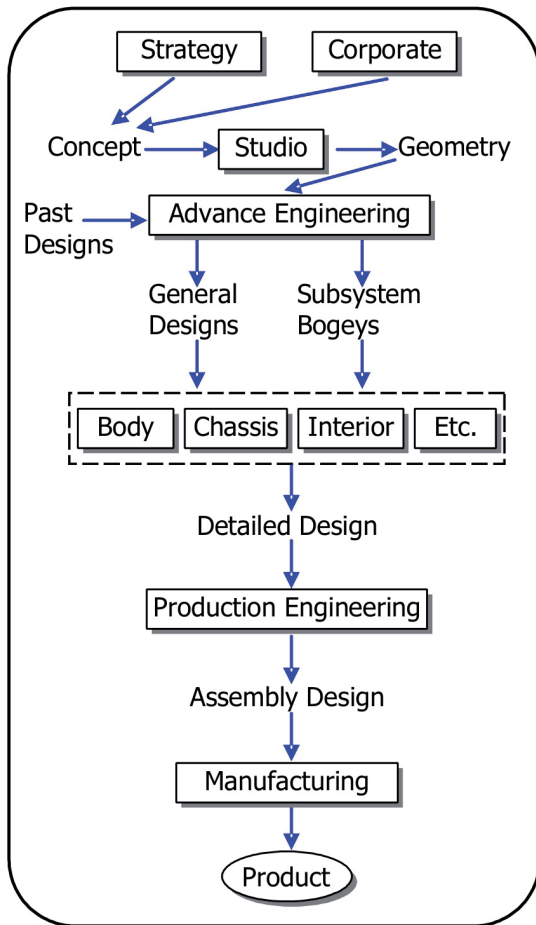


Fig. 2. Vehicle Development Plan

### 3. Translation routine from RADIOSS to LS-DYNA

The development of a new translation method is the aim of this work: we'll execute a detailed software-independence translation, which is an input data translation by a methodology independent of the finite elements calculation environment; that routine automatically realizes the code translation, which allows reducing drastically the product development time.

The translation has been carried out and tested on two vehicle models prepared for a full frontal crash against USNCAP rigid barrier: Fiat Stilo and Alfa 147. Although test-cases are few, the routine could be generalized to whichever RADIOSS model, on condition that the model's cards keep the files converted formulation.

Methodology is realized with the aid of TextPad text editor, Matlab 6.5 calculation software and Hypermesh pre-processor.

The TextPad use is necessary in order to carry out a suitable macro-operation on the text file developed in RADIOSS environment; in fact the output files from a FEM pre-processor (input for calculation) are composed by millions of lines, and

therefore they determine a memory occupation of 80-150 Mbyte and a high calculation time during the translation carried out with Matlab. In order to reduce the calculation time, and than product development time, the lines, that are not translation object, are sponged out from FILE.D00 by suitable macro realized in TextPad, so that Matlab works up files of 15 Mbyte at most for each translation routine. Also the lines that contain the cards that Hypermesh automatically convert, are sponged out. In the Figure 5, the flow chart is represented and described; this allows the way-out from RADIOSS to LS-DYNA environment.

#### 3.1. Calculation time

Within every algorithm there is a temporizer that evaluates the execution time in each routine. In this way, at the end of each calculation, for the six translation routines, the number of seconds necessary to translation operation appears on video. The processor on which the following times have been evaluated is an Intel Pentium 4.0, 2.6 GHz. The Figure 3 shows the total computation time.

	Matlab1	Matlab2	Matlab3	Matlab4	Matlab5	Matlab6	Totale
FIAT STILO	1 min	1 min	1 min	30 min	1 min	1 min	35 min
ALFA 147	4 min	2 min	7 min	30 min	15 min	1 min	59 min

Fig. 3. Routine time

For the whole translation it is necessary to add the operations carried out with the TextPad editor and the Hypermesh pre-processor, whose computation times are shown in Figure 4, and to contemplate the execution times of that operations.

Following this way, the translation has been executed in a maximum time of 4 hours.

	Hypermesh	TextPad	Totale
FIAT STILO	120 min	24 min	144 min
ALFA 147	120 min	24 min	144 min

Fig. 4. Hypermesh and Textpad times

### 4. Conclusions

The whole translation could be carried out without using Matlab, but only with the Hypermesh pre and post-processor and with the manual correction of the cards which compose RADIOSS model. However it has been estimated that the time to carry out that procedure is about 60 hours. Therefore the developed reduces a lot the product development times, that is the Time To Market (TTM).

The TTM reduction implies, in fact, the passage from a tasks sequential flow to a simultaneous flow, in which more steps are carried out side by side, in particular on the Product Development Plan beginning.

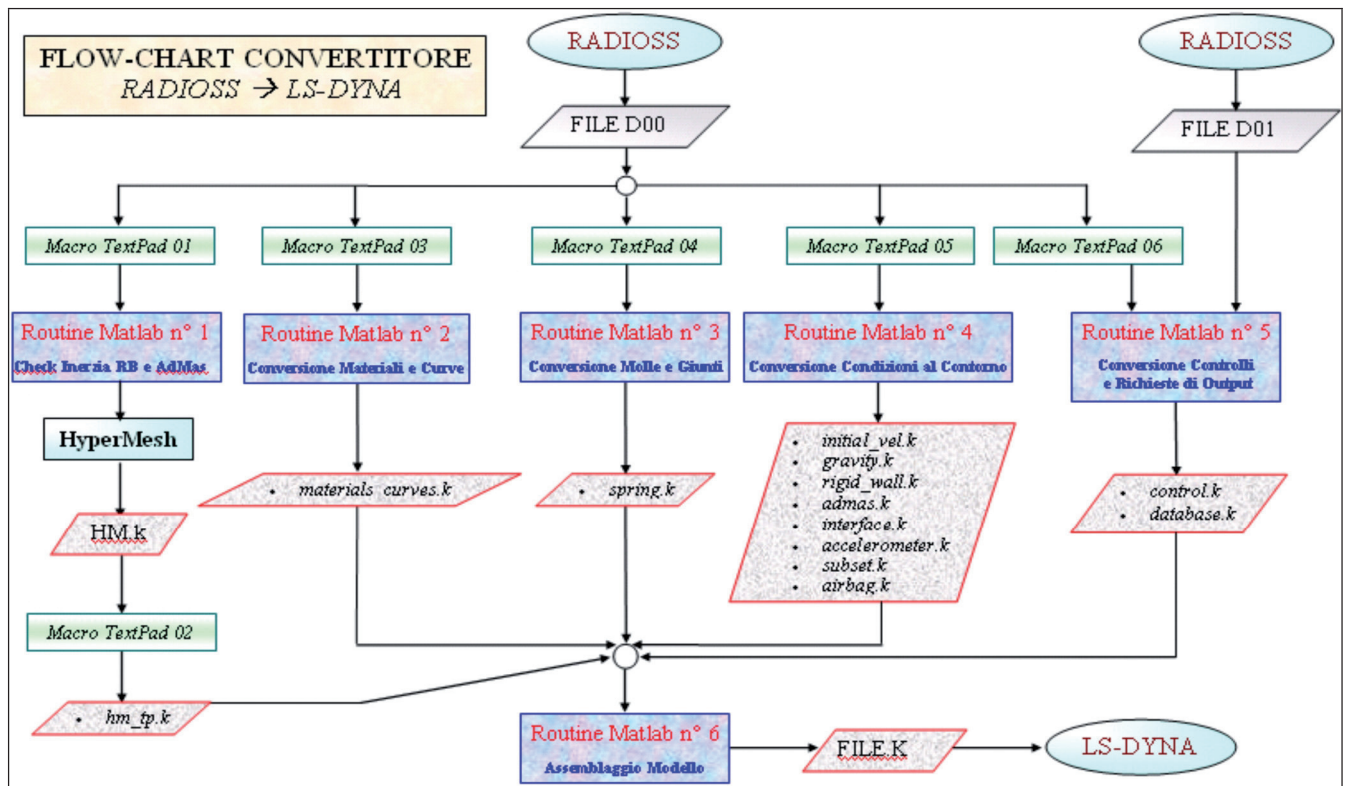


Fig. 5. Flow chart converter

That means also an efforts concentration in a moment in which every change is little expensive, in order to analyze and investigate the several options. It is also evident that, from point of view of the costs, the maximum effort has to make during the development formulation step, since this is the moment in which the great part of product life total cost is defined.

Moreover, the development plan initial step is characterized from the realization of many activities in a virtual environment, in particular in that of the virtual prototyping, which is sure facilitated and accelerated by information methodologies. An example is just that work, which influences on the calculation models preparation time, that is the propaedeutical step to homologation tests realization, in crashworthiness optic.

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