The changing role of simulation modeling: from a manufacturing re-engineering project towards the Corporate Model [1]

A real case study from the aircraft manufacturing company

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Abstract

The study presented in this paper concerns a case study conducted in a medium size aircraft manufacturing company. The paper discusses a changing role of a simulation model throughout the lifecycle of manufacturing re-engineering project. The original goal of the study was to gain a deeper understanding of how the existing production line of an executive class turboprop aircraft would respond to an increase in the production rate and use the acquired knowledge to improve the existing manufacturing process. As the final result of the study an interactive learning environment has been produced to stimulate new ideas and improvement initiatives. The modeling study also served as a small-scale prototype project before engaging into a large-scope modeling activity, developing a corporate model that relates all the main functions of the company, such as procurement, production, logistics, human and capital resource acquisition and allocation, marketing, sales, financing, research and development, and is aimed at the design of robust policies for improving the company's performance and reinforcing the organizational learning process. The paper further discusses the lessons learned from the prototype project and sets the framework for the future work.

Keywords: simulation, manufacturing, re-engineering, interactive learning environment.

[1] The authors wish to thank Jose Di Mase, the CEO of Piaggio Aero Industries S.p.A., for providing active support to the System Dynamics project and Professor Pål Davidsen (University of Bergen, Norway) for generous assistance and encouragement throughout the process. We also want to thank E. Maffei, B. Brill, S. Gamalero, R. Masala, D. Picone and P. Petrini for their valuable contribution to the project.

Extended Abstract

The study presented in this paper concerns a real case study conducted in a medium size aircraft manufacturing company. The original goal of the study was to gain a deeper understanding of how the existing production line of an executive class turboprop aircraft would respond to an increase in the production rate and use the knowledge acquired to improve the existing manufacturing process. In order to be more focused and reduce the project to a manageable scope, the most critical segment of the production line was identified and studied in detail. A simulation model was developed to capture the structure and the dynamics of the production processes that take place in this segment of the production line. The preliminary results demonstrated that the segment under study could not support the required production rate. At a later stage, an internal inter-functional team of specialists, involving the manager of the area under study, an industrial engineer, a person responsible for the parts supply, a person responsible for planning and control, was established to address the problem at hand. They suggested a list of alternative plans to re-engineer the production process. At this point the simulation model was developed further to support evaluation of alternative re-engineering plans. Thus the model was used as a decision support tool, which led to the identification of the best way to produce the critical sub-assembly of an aircraft fuselage. The re-engineering approach chosen required a substantial investment in the design and building of a new piece of industrial machinery. Throughout the entire process, the involvement and support of the top management was invaluable and a precondition for success.

A common language was required to make the communication effective among diverse members of the project group. The simulation model served as a unifying link to make the group work coherent and focused. Given the diversity of the expertise of the project group members and knowing that most of them could not spend a sufficient time on the details of the modeling language, it was decided to develop a user friendly simulator with the intuitive graphical user interface on top of the simulation model (fig. 1). This allowed for the introduction of modeling concepts without alienating the members of the project group and enabled them to converge quickly towards the core of problem domain.

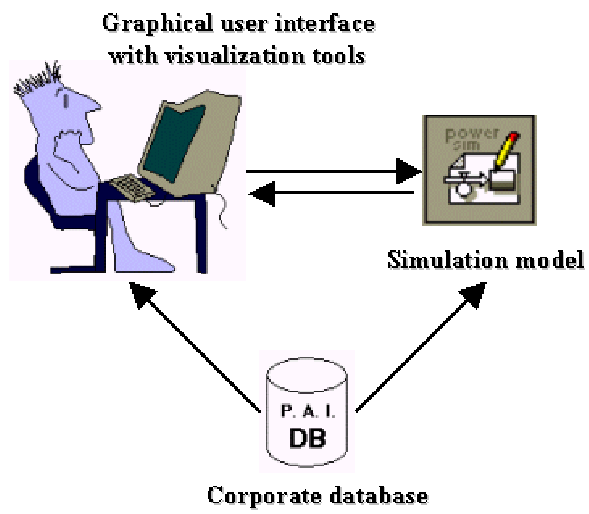

Fig. 1 Simulator architecture

This paper discusses a changing role of a simulation model throughout the lifecycle of the given re-engineering project. First of all, an aggregate model of the production line was developed. This model, based on the expert knowledge of the production, helped to identify the critical segment of the production line. Later a completely new model was developed. The new model was used to focus on the details of a critical segment of the production line. Using this simulation model, it was realized that the production process in use at that time had to be changed, because it was not able to support the required production rate. Later, the simulation model was modified to represent the alternative production method proposed by the project team members. Then the simulation model was transformed into a visual simulation tool and used to present the project results to the top management. At this stage the model served as a main discussion platform. Simulating various scenarios helped analyze the pros and cons of alternative modifications of the manufacturing process. As the result of these discussions, the best alternative was identified and the required implementation initiative was activated. During these discussions, it was recognized, that the simulation tool could be used to disseminate the new knowledge about the critical segment of the production line throughout the organization. Namely it could be used to train the current staff and new workers directly employed in the production segment under investigation.

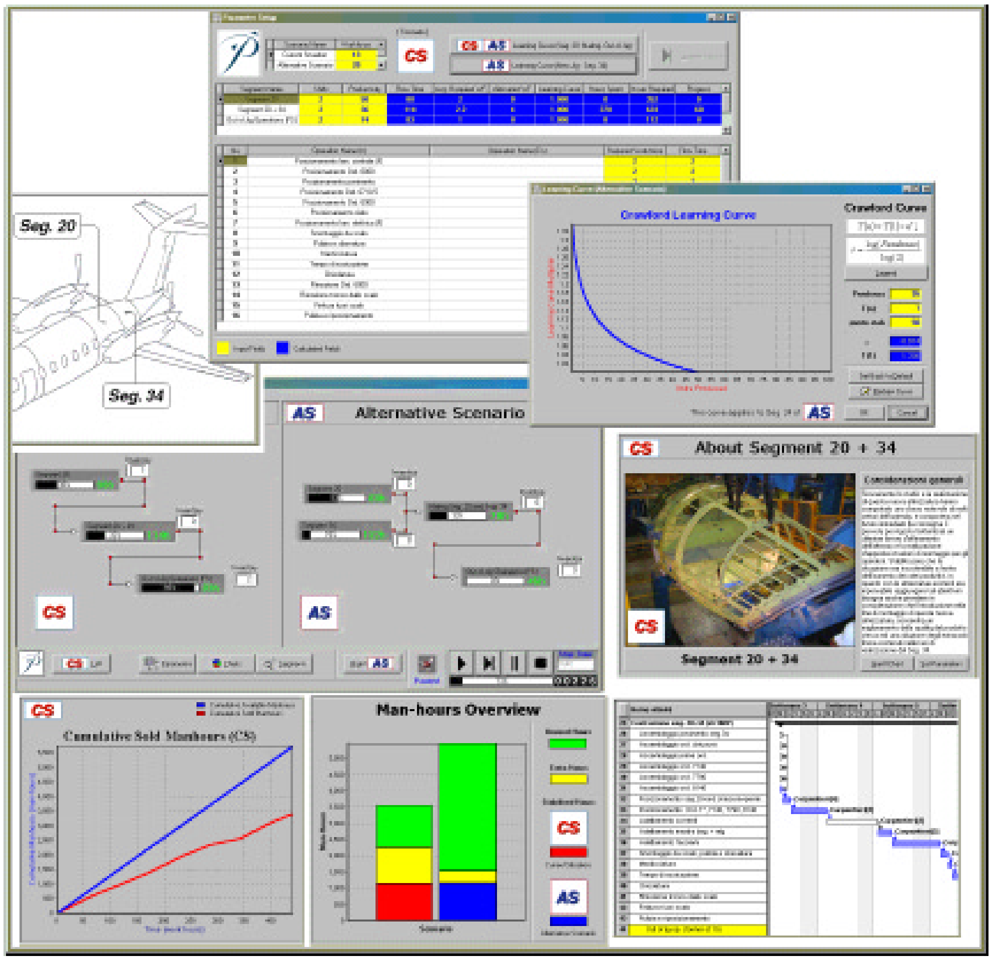

Fig. 2 Screen-shots of the simulator

To construct the simulation models involved, we used a combined approach. We grounded our study in a system dynamics methodology, but given the discreet nature of some of the production process we were obliged to include some discreet event mechanisms into our models. The model was developed using the Powersim Constructor modeling environment. Borland Delphi 4.0 was used to develop the graphical user interface (fig.2), which served as a user-friendly front-end on top of the simulation model.

The model-based study discussed in this paper served as a small-scale prototype project before embarking on a large-scope modeling activity, which concerned the development of a corporate model (fig.3) that relates all the main functions of the company, such as procurement, production, logistics, human and capital resource acquisition and allocation, marketing, sales, financing, research and development.

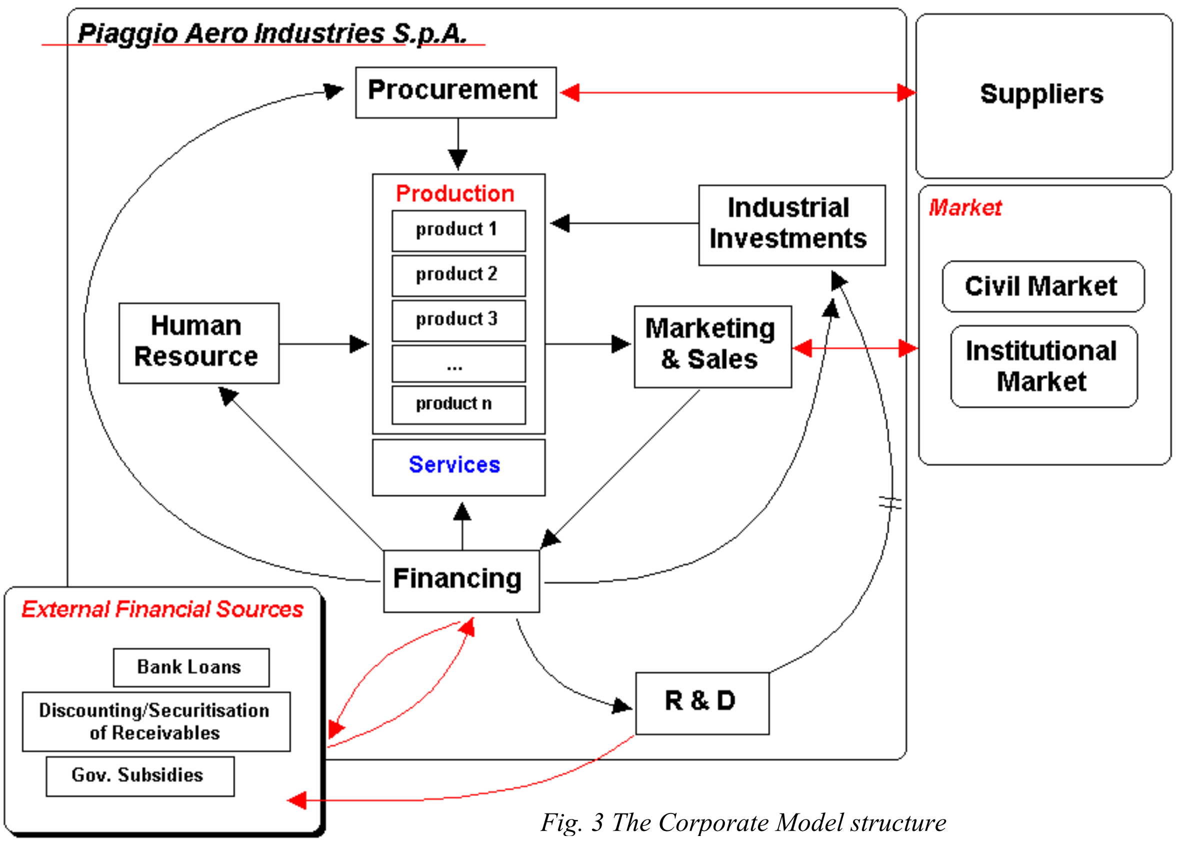

Fig. 3 The Corporate Model structure

The Corporate Model (fig.3) and actually the development process itself should bring a number of benefits for the company. The potential benefits could be grouped into two broad categories: the knowledge sharing and the simulation support to the policy development and decision-making.

The knowledge sharing
• Bring to the surface mental models of different company stakeholders in a clear and objective way • Develop a common language to address company's issues • Get a broad view of the existing interrelationships between the variables • Reinforce interactive learning process
The simulation to support policy development and decision-making
• Develop a better insight to the system • Provide a safe place to test policies and decisions • Give possibility to compress time and space • Stimulate new ideas and opportunities for action • Help to identify new business opportunities.

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