

INDUSTRIAL MODELLING AND SIMULATION SKILLS EVALUATION PROCEDURES FOR RESEARCHERS

Agostino G. Bruzzone, Enrico Bocca
MISS - DIPTEM - CIELI - University of Genova
Via Opera Pia 15 – 16145 Genova, Italy
st.itim.unige.it

Marina Massei, Enrico Briano
MISS - Liophant Simulation
Via Molinero 1 – 17100 Savona, Italy
www.liophant.org

ABSTRACT

Nowadays there are several techniques and systems that allows rational evaluation of candidates' skills and make simpler the researchers' work; so in this paper the main goal is to present an innovative way of evaluation of engineering performances and capabilities for candidates with background in industrial modelling and simulation.

INTRODUCTION

It is interesting to underline the potential of the use of quantitative computer models and simulators in order to guarantee a significant support for the evaluation and recruitment of well-prepared young resources in engineering field.

Nowadays the standard human resource evaluation/recruitment procedures are based on analysing and solving little case studies, working alone or in team, evaluating carefully the skills of the candidates while solving problems and their team working capabilities; however with the new approach proposed by the authors based on the use of simulation models it is possible also to evaluate interactions, results, problem solving and reasoning, even if a problem on evaluating different solutions in term of effectiveness may occur.

In effect one of the main current problems for young post-graduated resources is that their capabilities in problem solving are strongly reduced by the qualitative approach applied in the recruitment policies. Computer may be used as a useful tool in order to simplify complex calculating operations and to face with the different scenarios that may occur.

During the recruitment process the candidates usually analyse the test case and provide a reasonable solution,

identifying criticalities, bottlenecks and economic analysis, especially in terms of costs or revenues, but almost all these parameters are only qualitative, and so it is very difficult for the researcher to have a strong detailed feedback on the proposed solution; for these reasons the authors have proposed the introduction of computer models devoted to provide measurable output: so it is possible to evaluate real-time the impacts of the solutions proposed by the candidate in term of overall performances.

Quantitative computer models are the new frontier on the recruitment process: it is possible to introduce new possibilities like the use of the web technologies devoted to spread the selection base to a large community all around the world and to provide the candidates a self-evaluating procedure, but not only: using the computer it is possible, during the final selection stage, to evaluate also the interaction without obscuration of the originality of the single solutions. In the following some applications of this methodology will be presented as well as the results reached with this experimental campaign.

THREADS RELATED TO USE OF SIMULATION IN EDUCATION

The first field analyzed in this paper are the evaluation procedures in the education and training sector: these two areas are strictly linked and for a long time these sectors have benefited of the use of new techniques; for this reason it is interesting to evaluate the impact of the use of simulators and computer models, because it is very interesting to evaluate the solutions provided by students in the simulator, guaranteeing the possibility for the students to interact each other and to face with a "Virtual World".

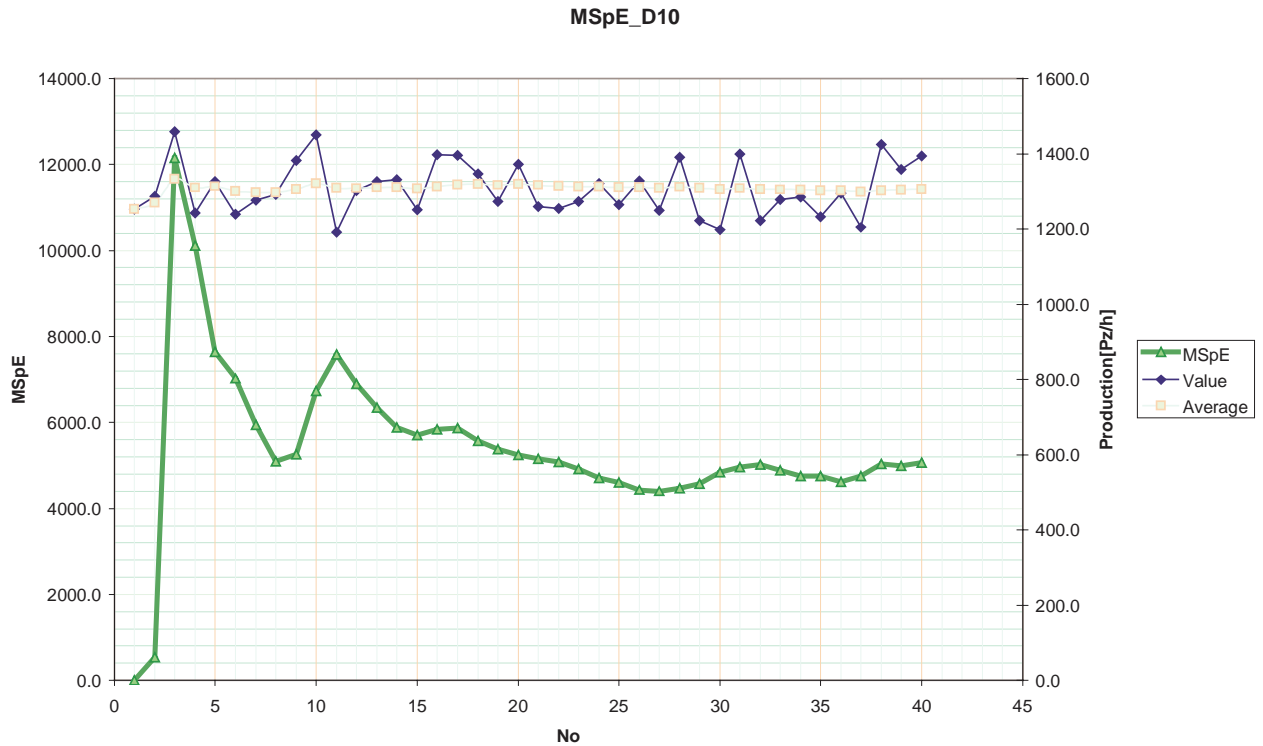


Figure 1: Example of Validation Report requested to Candidates based on DOE on a Simulator Scenario

With these tools it is possible to use models devoted to support real learning processes based on “Direct Experience”, but the changing is not pretty simple: the candidates have some preliminary requirements to satisfy, like good fundamentals (i.e. statistics), deep knowledge on DOE (Design Of Experiments) and similar methodologies, the awareness of the model constraints and limits, and so on.

The main concern about using this method could be related to the fact that the students, interacting directly with the models, could waste their time not discovering anything useful or losing their selves in a misunderstanding of goals due to the complexity of the systems.

In effect all the models proposed have inside approximations and this represents a further potential error source because operating in improper conditions the approximations could lead students to induct wrong relations from the simulation; therefore usually it is very difficult to discover those potential errors and to correct them, even because complex logical operations inside simulators are covered with very good looking and attractive animation or graphic that makes them look very realistic.

Even considering these aspects and risks the author experience shows that the main limit for using those

techniques in education is the lack of tool availability in this specific field; so there is a large potential for development of tools in this area.

SCIENTIFIC SKILL EVALUATION BY USING M&S

Simulation applied in the field of scientific capability evaluation and research selection is to be considered a logic step due to sector evolution: very often in effect selection procedures are nowadays based on the results of the approach of candidates to simulated scenarios. In this case the term “simulated” is not linked to computer simulation, but in a certain sense it is more understandable how computer M&S techniques could very usefully help to define those scenarios, in a realistic and challenging way not possible with other approaches.

Based on these possibilities it is possible to see a parallel with the evolution of the simulation for training especially in the military field, where the first steps were made in the middle of XX century, evolving to distributed operations in the 90s and continuously developing in present times towards automatic evaluation systems.

Testing Unitary Production

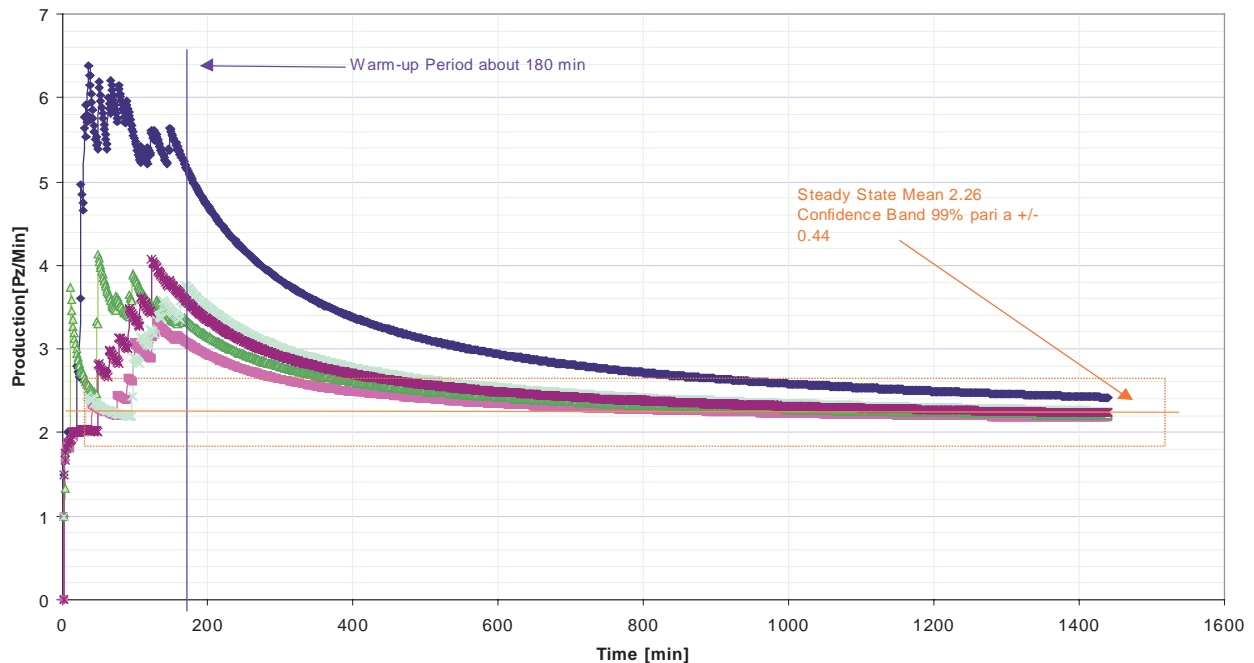


Figure 2: Evaluation Criteria applied to the reports provided by different candidates

But any case it is an innovative approach to define new models for operating in the personnel selection, such as:

- Fast screening for evaluating large numbers of candidates that operate on small but challenging system interconnected through the web interacting with simulation systems and communicating the results
- Complex problem remote analysis that can be submitted to the remote instructor by a group of trainees that can operate in a longer timeframe remotely connected.

Quick screening can enlarge the number of candidates allowing to concentrate the traditional screening, more time consuming and expensive, on a smaller and pre-selected number of candidates, allowing also to redesign the final selection procedure putting focus on additional issues. The second type of selection could be instead applied to quantitative comparison of experts with an effort limited for what concerns internal resources and procedure times. Using these approaches and other new ones in the process of researchers selection can lead to an improvement of evaluation approach leading to comparative and quantitative performance analysis.

In this paper it is proposed a set of preliminary applications in which to apply those concepts with the experiments made and their successful result.

CASE STUDIES AND APPLICATIVE EXAMPLES

The first example of use of computer simulation for researchers screening, presented in this paper, has been carried out in the academic personnel evaluation, it is very difficult indeed to bound research in a simulation model, but there are some specific situations in which research need a very deep integration with these particular expertise. The application was made in the engineering field, especially in the industrial engineering sector, that requires the capability of testing in a scientific way problems affected by variables to be measured, data to be analyzed and compared, conceptual liaisons to be estimated. In this case the capacity of the candidate to analyze and evaluate realistic problems using computer instruments in order to solve them can be identified using simulations models; in particular even if this is a very limited application of these concepts, it is important to underline how quantitative results based on computer simulation are useful to measure such skills.

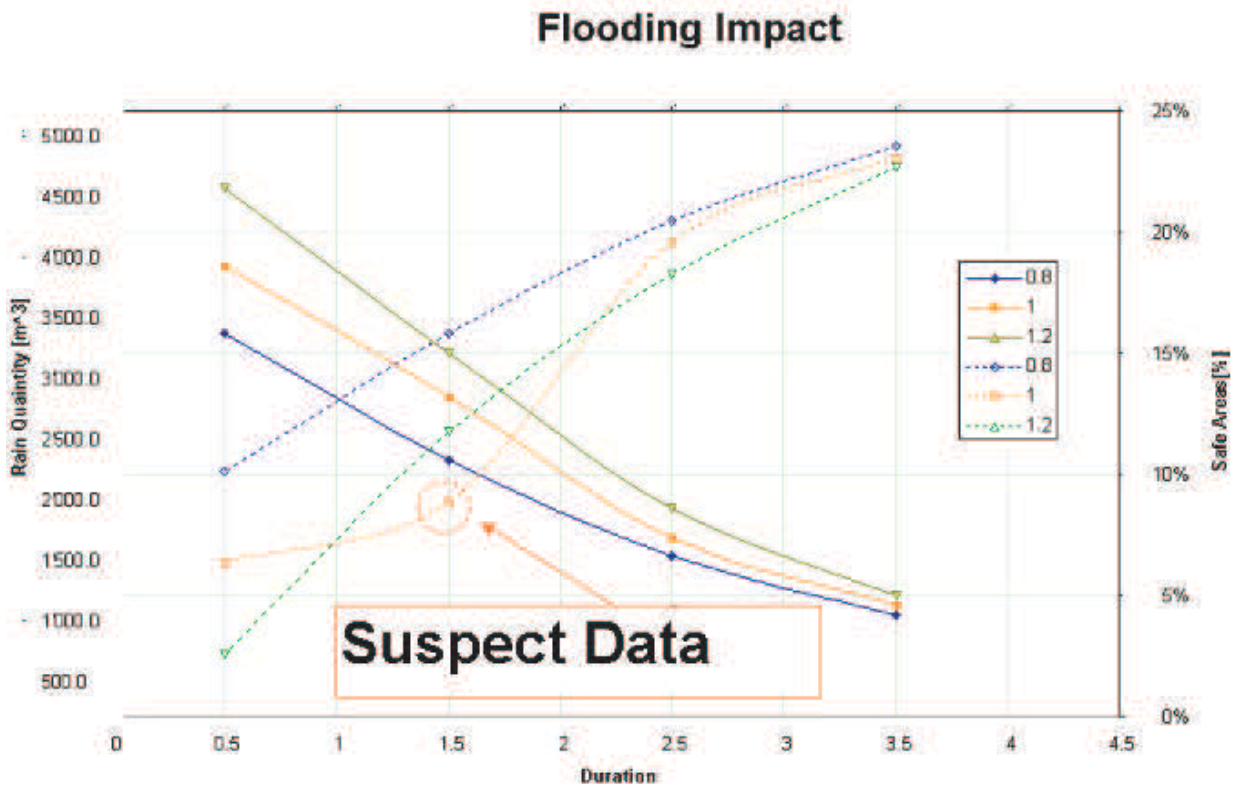


Figure 3: Setting up a Challenge in Data provided in a Scenario for a Researcher Selection

Obviously these results need to be integrated with other evaluation procedures in order to support effectively the overall selection process.

Let the authors introduce a set of computer simulation packages devoted to be applied in the sector of evaluating post-graduates for positions in academic environments; among the others some of the packages developed for industrial engineering candidates was related to different kind of simulators:

environmental management, mechanical department, manufacturing facility, engineering tenders, etc.

In particular focusing on the case For instance in the case manufacturing, it was request to estimated and identify the real system warm up period and the time baseline in order to obtain results to compared with real system data.

In addition on this example, the authors were developed other three different simulators tools to be applied in this sector to evaluate candidate focusing on more technical release in experimental techniques such as that related to complex systems: missile launching procedure, micro particle interactions, weather impact on flooding phenomena over a geographic region.

For instance In that example, in order to select different technical/scientific thematic areas the candidate has to identify some correlations, in particular comparing the results obtained by using simulation with the real data.

In this case, devoted to selection on different technical/scientific thematic area, the candidates was requested to identify, by using the simulator, some correlation also comparing the results with real data.

One important part usually is to request candidates to determine correlations among different factors and/or the goal is to identify the wrong data using the validated model.



Figure 4: Example of a Simple VB Simulator devoted to Candidate Evaluation

The tools was extensively used in researcher evaluation processes involving industrial engineering personnel, allowing to obtain a motivated quantitative selection quickly over a set of 45 candidates; the candidates able to pass the computer simulation was subjected to interview for final evaluation.

CONCLUSIONS

This proposed approach is indeed innovative and useful, providing very significant support in the selection of research technicians. On the basis of the results coming from these preliminary experiences it is possible to say that these techniques could provide solid and reliable performance measurement baselines and to focus on some aspects, allowing to focus on some others thanks to traditional techniques.

The extension of candidates' number applying distributed procedures for screening can add more opportunities for evaluation of researchers and also to improve their preparation. Meanwhile this approach allows a quantitative evaluation that could also be used by the candidates as feedback to improve their skills identifying precisely their errors.

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