# StypedJournal

SponsoredTeam for Young Petroleum Engineers Development

04-2010

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SPE International
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Hi everybody!
It's December and I would like to take this opportunity to convey the season's greetings of all the STYPED team, wishing everyone a Merry Christmas and a very Happy New Year!

Last September 2010, I had the chance to participate at the Annual Technical Conference & Exhibition 2010 (ATCE), which is the most important SPE's conference. As a Young Professional I was involved in Young Member Panel and Student PetroBowl IX organization.
I also participated at the Young Professionals Reception, an important session in which was recognized the professional and technical achievements by YP member.
In this occasion, I'm glad to present you the winners of the **3rd Annual ATCE 2010 Young Professional Paper Contest**, as the best paper written primarily by YP in the reservoir Engineering discipline:

***Franklin Gonzalez and Lucio Bertoldi,***
***"A fully Compositional Integrated Asset Model for a Gas – Condensate Field".***

Franklin and Lucio, two members of SPE YP Italian Section, work in eni e&p division – Milan. They were awarded on Monday 20th September during the ATCE 2010 in the Sala Della Scherma Terrace, at the Monumentale Building – Florence (Italy).

**Figure 1 - Franklin Gonzalez (on the left) and Lucio Bertoldi (on the right)**

**About the paper…**

***"A Fully Compositional Integrated Asset Model for a Gas – Condensate Field"***

*F. Gonzalez (SPE, Eni E&P); L Bertoldi (SPE, Eni E&P); A Lucas (SPE, BG Group); G Paterson (SPE, RPS Energy); K Shah; B Grewal, C Okafor, N Rodriguez (SPE, Schlumberger) – SPE 134141-PP*

A fully compositional Integrated Asset Model (IAM) has been built for a giant gas-condensate field. The field is a complex retrograde gas-condensate reservoir with a hydrocarbon column up to 1750m in height. The fluid composition varies significantly with depth, ranging from a gas condensate to under-saturated oil.

Production is centred on three processing facilities which are variously constrained by gas processing, gas compression & oil stabilisation capacities and overall export levels. There are some 100 producers and 15 gas injectors presently active in the field, with new wells and facilities planned as part of future development.

IAM's for the total production system have been gaining in popularity for applications such as FEED studies, field development planning and optimisation. Their complexity has grown with the need to have fully compositional models, which are particularly important for gas condensate fields, where accurate fluid description is required for predicting condensate recovery and injection gas composition.

Development of this IAM has required close cooperation between reservoir, production and process engineers since each of the component models - a 3D reservoir simulation model, production & injection surface network models and a process model for the three production units – are complex in their own right.

The IAM model honours the well, network, and facilities constraints, taking into account interdependence between the different elements of the system.

The IAM provides the capability to manage scheduled field events (well re-routing, plant maintenance, field uptime, etc) and optimizing field liquid production.

This work offers valuable insights for more accurate assessments while evaluating different field exploitation strategies.

The first simulations highlighted the following remarkable results:

- IAM enabled diameters to be reduced significantly:
**savings of 76 km of pipe = ~100 M$**
- IAM showed that the originally planned inter-facilities transfer lines are not required:
**savings of 30 km of pipe = ~40 M$**

- IAM identified spare liquid and gas capacity in some process facilities:

**Consequently was considered a well re-routing options that shows an incremental 1.2 MT liquids production for ~10M $ investment.**

IAM workflow is showed in figure 2; below a brief description of each component to give an idea of the system complexity:

1. **Reservoir simulation model** is a 12 component equation of state compositional model which is periodically history matched; it consists of 123K active cells and some 100 wells. The fluid composition varies with depth from gas condensate to undersaturated oil.

2. **Surface network models** were created for the production gathering system and the gas injection system, utilising a multiphase flow simulator. These models extend from the well heads to the process facilities, and comprise some 520 branches.

3. **Process model** was built to represent the surface facilities with sufficient detail to meet the requirements of the IAM.
   The facilities included are the existing Units A, B and C and the planned new gas-oil separation plant (Unit D).

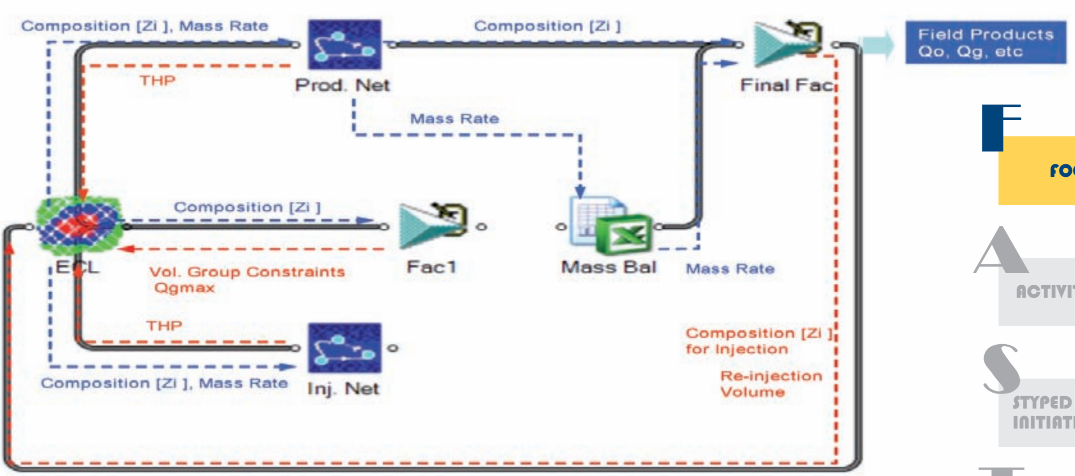


**Figure 2 - Image of the IAM model**

# “On the field…”
# Roberta Cestaro, eni e&p division

I have been working at eni – Milan for about three years. I am in COMP dept., the completion department and in particular I am involved in artificial lift activities. My job includes different aspects: first you have to study the problem, second you have to design the best artificial lift system for it and at the end sometimes you have to go to the field to see the completion run in hole.

During the training period, I attended many courses in order to learn the most important aspects concerning my job...it was very difficult to understand intuitively something that you know only from a theoretical point of view.

In April I had the opportunity to spend one month in Egypt to see different type of artificial lift system.

When my boss gave me this news, I was excited but worried at the same time: that was my first time abroad for work, alone and for one month! During the last day in Milan before my departure a lot of my colleagues and friends gave me warning about the condition I would have found. The hot temperatures, the different language and culture, the distance from my family and my habits…

This experience started as a training period in IEOC (eni’s associate in Egypt). The first week in Cairo was like an usual working week. I spent my days in IEOC offices, I met all the people involved in Artificial lift design to learn as much as possible about fields and production wells. I spent some days in a contractor workshop to see as much as possible about assembly and disassembly of electrical submersible pump.

At the beginning, to get into the Arabic world has been a very strong impact, everything was strange: the living condition, the language, the food, the Arabic tradition. However the adventure began with the flight towards Abu Rudeis: one girl taking this little plane with only men above… One of these men asked me if I had taken the wrong plane!!!
Abu Rudeis (the first field where I was) is a town on the Suez Gulf seacoast, on the west side of the Sinai Peninsula, 200 km off the Sharm and Sheik tourist resort.
The landscape all around is nice: the colours of the sea contrasting with the red sand.
At the oil field there are about a thousand of Egyptian men and only five Italian colleagues. I met many kind people who helped me in every situation but some of them refused to greet me withdrawing their hand and looking at me.

I was aware of this attitude, but at the beginning was strange!
The working experience has been very interesting; I have seen different type of artificial lift system and operation in onshore and offshore wells. Almost every day I used to go from one rig to another depend on the daily operation.

**Figure 1 - On the Field**

I had a similar experience in another field: Melehia field located in the western desert.
The landscape all around is desolate because for kilometres and kilometres there were only stones and sand.

**Figure 2 - Melehia Field – Western desert**

There was only one Italian man in the field. Fortunately Carmelo has been very nice and he attended me to see different operation despite of the weather was very hot and he had a lot of work to do! During the day there were 47°C and for me was difficult stay all the day outside!
The working training was very important and interesting, because I have had the possibility to see many operations on the field and to speak with colleagues that have explained me about their past experiences.

But this experience has been complicated from different point of view: for example I missed the freedom to go outside alone, to practise my hobbies and my daily habits…I challenged myself but I succeeded thanks to the nice colleagues I met.

**Figure 3 - Dinner on Field**

I’m glad to present you the last lecture of 2010 SPE YP Initiatives:


**10th November 2010, 5 – 6 p.m.**
**Sala Barbara – V Palazzo Uffici eni e&p Division**

The lecture program was included in the offer of activities promoted by SPE YP section, for diffusion and sharing of alternative points of view to approach problems and topics related with the petroleum business.

This lecture was taken on 10th November 2010 in eni e&p division, V Palazzo Uffici in San Donato Milanese – Sala Barbara, with the presence of about 30 people in the place and with the novel introduction of an efficient form of webinair, in order to transmit the conference to all SPE attendance who are not able to be in Milan to join the conference.

The webex system, consistently tested in other occasions, allows creating an active participation of remote attendances with the use on on-line vocal and textual chat, in addiction with the live transmission of the lecture. It this occasion Baker-Hughes in Pescara and Total in Rome joined the lecture via web, actively participating in the discussion with questions and annotation in live-time.

Four focal point were selected in different places (Rome, Turin, Pescara, Val D’Agri) to be the reference persons to organize the transmission of all SPE Italy activities, not only in company offices but even in universities, such as Politecnico di Torino.

The YP Board planned to broadcast all oncoming activities via web, in order to largely increase the number of attendances and involve all SPE members in a more proactive way, let them able to easily share their ideas and experience in the activities of the organization.

We will keep you informed of all SPE YP activities for the next year, that we are currently planning; if anyone have some ideas or initiatives to propose we will be happy to confront and elaborate new topic with all of you.

## Economic Evaluation of Ecosystem Services and Stakeholder Engagement: Key Strategies for the Oil & Gas Industry

***Paola Sabina Lupo Stanghellini*** is an environmental economist; her research activity is focused on natural resource management.

She was involved in projects concerning the implementation of the Water Framework Directive and focused on: development of stakeholder analysis methodologies and tools for participatory decision-making processes; economic evaluation of ecosystem services and environmental goods; cost-benefit analysis. Furthermore she worked on advice projects for the ENI Group focused on sustainability in the oil&gas/energy sector and concerning: development of stakeholder management systems; implementation of stakeholder analysis and social baseline analysis in relation to socio-economic projects; planning of mitigation and compensative measures in relation to exploration and production activities.

**About the lecture…**

With respect to stakeholder management, one of the most important challenge for the Oil&Gas industry is to actively promote stakeholder engagement, in order to build consensus and collaboration between parties, manage expectations, prevent disputes, avoid protests, reduce problems with regulatory authorities - such as licensing delays, estimate in a better way and optimize socio-economic costs (like resettlement) and resources required for mitigation measures, meet the requirements of financial and aid institutions which may be important to the company.

With respect to ecosystem management, the Oil&Gas industry needs to take into consideration the economic valuation of ecosystem services, in order to correctly quantify their values and potential damages and, as a consequence, to assess costs, impacts and risks of a project/activity in a better way.

Recent events have shown that when stakeholders and ecosystems issues are addressed in an inadequate way, consequences may be very bad. On the opposite, addressing stakeholders and ecosystems issues in an appropriate way can positively influence the project design and the decision making process, improving the quality of the planning phase and the efficiency of the implementation phase, especially with respect to exploration & production as well as reclamation & restoration activities.

The lecture was divided in three sections: Definition and evaluation of Ecosystem Services, Stakeholder engagement and methodologies for stakeholder assessment, Case Study.

## INTRODUCTION

Currently, development and management of oil and gas assets have become an economically and technically challenging process.

It requires an involvement of a multidisciplinary team composed of skilled process and control engineers, petroleum engineers and geologists. Unfortunately these disciplines often do not address problems from the same perspective although the goal is the same: to manage the asset in order to maximize production.

In recent decades the introduction of integrated asset studies, based on Integrated Asset Models (IAMs), have been developed. This methodology allows production engineers to simulate the asset combining subsurface models with surfaces production and process model.

Generally these studies are carried out by reservoir engineers to predict production profiles.

Eni e&p Production Department has developed a tool using IAM not to predict production but to give technical support to operation engineers in day-to-day decisions (suggesting, for example, choke valve settings, well routings, separator pressures, reboiler temperature) taking into account reservoir features, wells and gathering characteristics and process constraints.

This tool has been tested successfully on an eni asset.

The tool enables production engineers to evaluate different scenarios, each of them characterized by a set of operating variables. An HMI allows users to change operating variables and to display relevant data.

In the case of assets with a high level of complexity, an optimization function can be used in order to identify the best asset configuration (the scenario characterized by the highest production) that otherwise could be difficult to identify directly by experience or by classical optimization processes or by the tool trying to change the operating variables; in fact, the experience shows that the optimum of the asset is not simply the sum of the best well configuration, the best gathering system configuration and the best plant configuration but the potentiality of the whole asset is less than the sum of the potentiality of its parts.

## INTEGRATION PHILOSOPHY

The aim of integration is to understand the behavior of a network system and plant processes linked together, defined a set of operating variables.

This tool is designed for production engineers. Its goal is to supply a set of useful information in a short time.

Widely known software packages in the company have been used in building IAM: GAP software for modelling gathering systems, HYSYS software for modelling oil/gas production and processing plants, RESOLVE software that enable GAP and HYSYS models to be integrated and to display results (see figure 1).

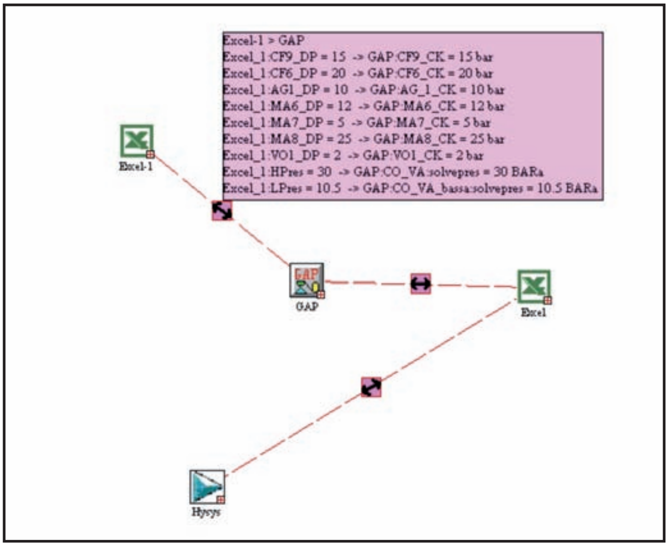


**Figure 1 - Link between HYSYS and GAP trough RESOLVE**

Integration is characterized by rules and hypothesis that don't depend on the kind of simulator chosen to treat data, and they are addressed on the results that designers are looking for.
Some of these hypotheses depend on the availability of field data, others from the workflow of the company.
Integration of specialized software, such as network and process modeling, requires some hypotheses and rules that clarify the boundaries and functionalities of the tool.
Black oil approach has been adopted in network model to calculate the flow rate of each well fixing a value of flowing well head pressure. When the flow rate of each well is known then the hydrocarbon mass flow rate of each well is imposed on the process simulator (to the stream that contains the properties of the well analyzed).
In process simulation, there is a stream for each well. The stream is completely defined in terms of composition, pressure and temperature while the mass flow rate is defined by results of network simulation.

Using a simple mixer it is possible to calculate the feed stream composition, for example if well1, well2, well3 are producing in high pressure (in GAP file) it means that in process simulator well1 well2 well3 will collect in the high pressure separator stage.

Following this approach, the networks model and the process model are sequential and independent. This means that the two programs can run separately, thus it's possible to freely manipulate each simulator to fit field data so people who build network simulations might be not the same people that build process simulation.

Following this kind of approach, the black oil model, tuned by the reservoir department, is used for gathering networks and, on the other hand, the process is analyzed, considering fluid with a compositional approach without critical delumping operations that could destabilize simulation and lead to less accurate results.

The hypotheses to build an integrated model are:

1) Constant fluid composition.

Black oil approach has been adopted for the network model. This involves characterizing the oil as a simple mixture of gas, oil and water, rather than requiring detailed composition data and simplifies the calculations required, thus reducing computation time without decreasing the quality of final results. According this assumption, each well is characterized by a fix composition (independent from FWHP), a fix value of GOR and a fix value of WC that can be refreshed through updater data.

As the modeling of the gathering network typically involves calculating pressure drops, the lack of detailed composition data will not lead to significant errors.

2) Steady state conditions.

Both the Gathering Network and the Process Plant have been modeled in steady state, rather than dynamically; as a result, time dependent effects (e.g. slugging, shut down or ramp up conditions) cannot be modeled.

Another effect of this choice is that all the data used in the simulators is considered fixed (well performances such as Production Index, reservoir pressure and other time dependent variables).

This means that all new available data (new test separator, gas analysis, Δp in gathering network, new PI) have to be inserted to update the model.

It is important to highlight that the tool is not designed to make forecasts.

3) Boundaries of the system.

The tool is designed to simulate assets from sand face to delivering point. It starts at the well head choke valves and includes the gathering network,

manifolds and transfer lines as appropriate, the processing plant up to the point at which the sales products (either gas or crude oil, and associated by products) leave the plant.
So it does not include any sub-surface modeling, therefore data regarding wells have been provided by reservoir engineers. These generally are in the form of PROSPER files which can be imported directly into GAP model. It is important that a dialog takes place between reservoir engineers and engineers producing the IM to ensure that the limitations of the well data provided are understood.

Integration follows a "top down approach" characterized by the following steps:

- Through HMI (an excel spreadsheet) the user sets the input operating variables, typically the choke valve pressure drop for each well, in the gathering network model (GAP).
- GAP simulates the network to predict the flow rate of well fluid from each well to the processing plant.
- Hydrocarbon flow rate of each well are transferred into HYSYS. Process model figures out the flow rate of each fluid component, water, gas and oil.
- The results of process simulator are written, displayed and grouped properly in tables and charts (see figure 2).

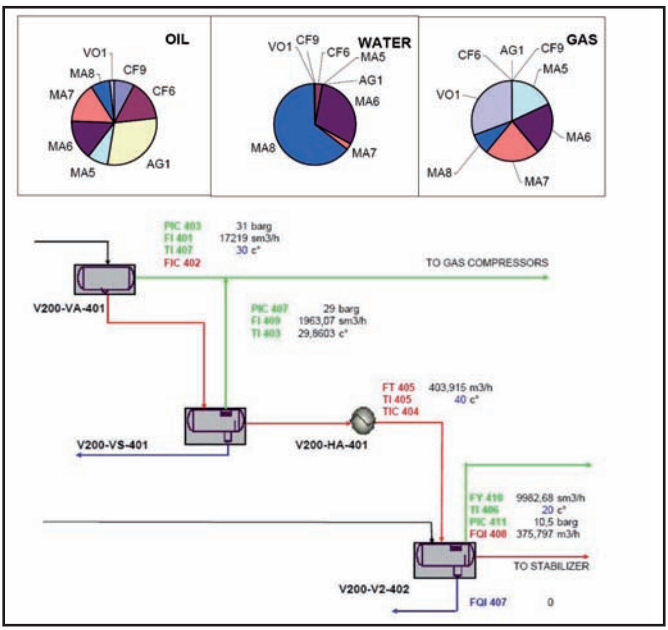


**Figure 2 - Spreadsheet showing some relevant data output from IAM**

Top down approach may change in the case of gas lift. In this case it is important to check if process is able to treat the amount of gas (the gas associated and the gas used for gas lift).
The added value of integration consists in the opportunity to compute and to analyze a wide range of scenarios.

Thanks to integration it is possible to:

- have useful suggestions on well routing;
- analyze the impact on production changing operating variables
- understand if a change in plant layout or in gathering network layout can cause bottlenecks.

**TOOL LIMITS**

Once completed, the tool enables production engineers to have a global asset vision and it is able to reproduce plant operating conditions. On the other hand it doesn't need a global vision (reservoir – wells – gathering system – process) in all kinds of fields.
For example, in the gas field, where fluid compositions are more or less the same, a process plant simulation and a gathering networks model (not linked each other) could be sufficient to manage and optimize the system analyzed. Besides, an integrated model doesn't give more indications than the use of a process plant simulation and a gathering networks model (not linked to each other) in case of plants unless condensate or inert separation. An integrated asset model is very useful in the analysis of an oil field characterized by oils with different values of GOR or in oil field characterized by the use of gas lift.

**CONCLUSION**

This is the first example of IAM used to give technical support to operation engineers in day-to-day decisions whilst generally IAMs are used to predict production profiles over the years.
Network models and process models have been built, validated and finally linked; a new asset optimizer has been programmed.
In common with all simulation models, if the input data for models is not accurate or missing, then output data reliability will be compromised.
It is extremely important to have a real picture of the asset analyzed. For this reason, it needs to update models, for example when a new well is drilled or new data from test separators is available or new plant equipment is added.
The tool has been tested successfully on an eni asset and now it is ready to be exported worldwide to any Geographic Unit because rules for its building have been defined and advantages in its use have been proved. The tool represents a point of reference for the next modeling developments.

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