FlexPlan

# Web consultation – Planning Tool Feature and Interfaces: summary of the received feedbacks

Feedback was received from the following experts:

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- Benoït Bletterie - APG
- Evangelos Vrettos – Swissgrid
- Ricardo Prata - EDP Distribuicao
- Tim Schittekatte - Florence School of Regulation

## Question 1 - Please describe the current planning tool which you are using:

- **Frequency of use (daily,weekly,yearly)**
- **Planning horizon considered for the planning (e.g. 5-years,10 years)**
- **Main user of the tool (e.g. analyst of grid planning department)**
- **Graphical user interface (Yes/no)**
- **Integrated with other systems (e.g. SCADA, AMI)**
- **Vendor or in house development**
- **Types of analysis performed (Load Flow, Probabilistic Load Flow, OPF, etc.)**

**Summary of received feedbacks:**

- On the frequency of use, responses vary from a daily to a monthly usage of such tool (note also that some participants assessed planning in a broader sense, also covering operational planning).
- Planning horizons from 5 to 20 years are typically considered (10 years being a typical mentioned value). Answers also mention smaller horizons (one month ahead, one year ahead), but this likely covers more operational planning, and not grid extension.
- Users of the tool are typically from the grid planning departments (or similar attributions). Asset management is also mentioned.
- Several (but not all) answers mention that a graphical user interface (GUI) is used in the current planning tool they use.
- The integration with other systems is in most cases not direct, even if an indirect integration (export from another tool in a format compatible which can be imported in the planning tool) is sometimes mentioned. Some direct integration with SCADA system (but more for operational planning) is reported by one participant.
- Tools used: answers mention commercial tools like PSS/E, PowerFactory Digsilent, EMTP, PSCAD, DPlan. integrated with SCADA (for operational planning).

- A wide variety of analysis has been mentioned, ranging from contingency analysis, remedial action optimisation, security analysis, OPF (voltage regulation), load flow analysis, fault levels, EMT analysis, Network investment benefits, operational planning and failure risk assessment.

**Critical analysis:**

The planning tool should be user-friendly since it is used on a very frequent basis and most people mention a GUI is used. Also, the current planning tools are used for a wide variety of tasks, and do not seem to be very integrated with other systems.

## Question 2 - In your current planning tool/methodology, what are the features that you lack (the most)?

**Summary of received feedbacks:**

Very diverse feedback was gathered from the different respondents. Here is a non-exhaustive list of features that would need to be considered according to the received answers:

- Improve the user experience of the tool in terms of automation and data interfaces
- Missing modelling features
    - Ability to specify the exact **discrete** combination of tap ratios and phase angle shifts that are feasible (as opposed to continuous representation).
    - Consider **topological adaptations and optimisation of dynamic network assets** in the operational problem, as an alternative to consider a fixed network (usually the case in current planning practices).
    - Consider **investment** (much faster than building new lines) in **dynamic network assets** (in combination to the previous point)
    - Merge the **market** and **network** modelling part to reach a better solution according to some optimization function.
    - Automated load connection

**Critical analysis:**

The feedback shows that it is important to work on the modelling aspect and that network assets should be considered in the planning tool. In FlexPlan, existing and candidates PST and HVDC will be considered. Other actions might be considered, but a trade-off needs to be made between the modelling and the computational tractability of the associated optimization problem (considering a discrete set of tap rations for PST is possible, but this involves the need of including binary variables in the optimization problem, which then makes it harder to solve).

## Question 3 - Which other (modelling) features should be considered in the planning tool in your opinion

**Summary of received feedbacks:**

Respondents provided very valuable and diverse feedback, that may be classified in different categories:

- **Dynamic Network Assets**

  - Consider manually/automated controllable/dynamic grid assets (including new electronic devices) as decision variables in the planning optimisation problem.
  - Discrete modeling of transformer tap positions and phase angles
- **Uncertainty/Probabilistic** aspects
  - Consider probabilistic demand growth
  - Combine the testing of uncertainty in future predictions with the ability to amend or redeploy assets (including the inherent timelines for reconstruction) to test the flexibility of solutions for a range of scenarios in a single step.
  - Include contingency scenarios in the planning problem
- Storage and **demand response** operation
  - aggregated (e.g. battery like) flexibility resources models
  - importance of transparence on methodology
- **Market power/regulatory** concerns
  - misalignment between private incentives and market efficiency (e.g. market power, inc-dec game)
  - potential conflict of interests of system operators
- **Network models:** according to some,
  - Ability to consider AC network models (since voltage violations occur more and more and thermal issues are not the primary reason as before)
  - Given the rise of renewables, the ability to predict harmonics omissions and EMT (electromagnetic transients) at a systems level will become necessary.
  - Possibility to perform network reduction on part of the grid
  - Consider network topology adaptations/remedial actions (including redispatch) in the optimisation problem
  - Consider maintenance decision variables for both generation and transmission assets

**Critical analysis:**
Many features have been suggested by the respondents. The uncertainty/probabilistic track, as well as demand response operation are well covered in the current work done within the consortium. We acknowledge that market power and regulatory aspects are important: it will likely not be possible to include this in the model itself, but discussions/recommendations will be made within the project (a dedicated work package on regulation is in place). On the network side, many suggestions have been made: while they are all of critical importance, it is likely that Flexplan can not cover them all, and this requires further discussion within the consortium. One of the main reasons for not considering part of them is the added computational burden, which might make the planning problem not tractable to solve in a reasonable amount of time.

## Question 4 - Do you have a preference on the input/output data model/format

**Summary of received feedbacks:**
No clear answer emerges from the different respondents. One of them mentions that "Given the range of tools required currently to do system studies and the acquired knowledge of companies in these, a

output/input format that can be universally applied will be necessary". Others mention text format (RAW UCT), or CGMES format

**Critical analysis:**
It seems important to be compatible with other tools/formats (e.g. CIM/CGMES), but not strict format is to be followed from the consultations.

## Question 5 - Might a different data model be a barrier for you to test in the planning tool?

**Summary of received feedbacks:**
Overall, respondents believe that it should not be a barrier, provided that a conversion functionality of the data format between current tools they use and FlexPlan data format exists.

**Critical analysis:**
If we want to have an impact and have the tool used in a DEMO stage at the end of the project, then the data model and format should be carefully chosen (compatible with existing formats), or it should be easy to convert the inputs/outputs in a format that is currently used (e.g. CGMES, UTC)

## Question 6 - Which standard should it comply to?

**Summary of received feedbacks:**
UCT and CGMES were mentioned several times, but also Fault level G74/IEC 909, Harmonics IEC 61000-3-6 and 61000-3-7 EMT Temporary OverVoltages IEC 60071-1 and 60071-2 ENTSOE latest CIM format compatible.

**Critical analysis:**
Flexplan can not comply to all the mentioned standards since it is a R&D project, but should aim at being compatible with UTC and/or CGMES.

## Question 7 - What must-have elements in the GUI would you need in the ideal planning tool?

**Summary of received feedbacks:**
Different aspects are highlighted by the few respondents. Among them are:

- **Output visualization** needs:
  - Visualization (based on a color-map or something similar) of the grid topology of the final solution showing the existing grid elements, the ones that need to be reinforced, and the ones that need to be newly added
  - Heat mapping for all system limited parameters: steady state and stability margins for voltage, current, phase angle, frequency, utilization factor, probability of failure, ...

- **Input** needs:
  - Configuration aspects: type of algorithm (e.g. Newton Raphson, Gaussian)
  - data inputs: line parameters (impedeance, voltage, length, ...)
  - Various dashboards on the grid model (power exchanges, total production or load in each area, …)
  - Easy to assess network areas with fragilities, and to pinpoint to assess details.
- **Actions**
  - trigger load flow and N-1 computation
  - toggle between Single Line Diagrame (SLD) and spatial layout (based on geographical location, and also impedance of circuit)
  - possibility to modify or add grid elements like transformers, lines, ...

**Critical analysis:**
Flexplan consortium will try to incorporate some of this feedback to design the prototype GUI planned in the project. However, this is not a production tool, and not all features will be possible to implement. A priority will need to be established on what is the most important to have as an output of the project.

## Questions 8/9 - In terms of input (scenarios) data, what are the most important features to have in a GUI according to you ? How would you like to parametrize/specify input scenarios in the GUI?

**Summary of received feedbacks:**
The most important features highlighted by the respondents related to input/scenario data are:

- load scenario data (e.g. load, generators, contingencies, ... ) through external files/connections with other systems, but also ability to adapt/fine-tune them manually
- Compare planning results (including in N-1 conditions) for different scenarios of demand, installed generation power, contingencies list
- The way to define scenarios should be as flexible as possible
- Ability to use multiple scenarios simultaneously and attach probabilities to them (individually or collectively). Also consider rare events (black swan events).
- Ability to perform sensitivity analyses on different (high-level) inputs (e.g. installed production capacity)
- Ability to modify network topology on single line diagrams

**Critical analysis:**
Overall, participants agree that they should have a high-level view of what the input scenarios are and be able to change high-level parameters, as well as correct detailed aspects when necessary. The probability aspects of the scenario should be well controlled in the input part of the GUI, and features like sensitivity analyses should be done. Here as well, a priority will need to be established between the different features to implement in WP3, considering the available budget.

## Question 10 - Would you consider the possibility to perform what if scenarios or sensitivity analyses as a must have or nice to have ?

**Summary of received feedbacks:**
All respondents agree that the ability to perform what-if scenarios or sensitivity analyses are a must-have feature. On top of this, one respondent highlights that results should better be presented as distributions, rather than average values. Distributions give a better insight in possible "tail-risk/opportunities".

**Critical analysis:**
It seems clear that these features should be prioritized and they will be considered in the tool design. However, the questions of the computational tractability or time should also come into play here.

## Question 11 - In terms of outputs, are dashboards useful to develop? If yes, what are the key elements you would like to see as an output to the ideal planning tool?

**Summary of received feedbacks:**
All respondents agree that dashboards are very useful to visualize both results, but also input data. As main features, the dashboard should allow to:

- visualize required reinforcement and/or expansion measures
- visualize results of N-1 computations (e.g. using heat maps)
- visualize total systelm demand, generation, storage, demand response, available generation/storage/DSR by type, nodes with min/max voltage, interconnections levels, reserve margins

**Critical analysis:**
It is essential that dashboards are developed in the GUI of the planning tool, both for helping stakeholders to test the tool in a demo setting, but also this will help to do the work in the regional cases analyses of the FlexPlan project.

## Question 12 - In terms of interfaces, should the planning tool ideally integrate with other tools you are/will be using? If yes, can you elaborate?

**Summary of received feedbacks:**
Most respondents agree that the planning tool should ideally integrate with other tools, such as:

- Loading of market data (from a market analysis/simulator) as a first step in Grid planning studies
- Integrate with EMS, SCADA or RTDS systems such that import/export of system states may be used to test the validity of the planning tool results.
- Some legacy databases

**Critical analysis:**
There is not a strong alignment on the tools with which the planning tool should integrate with. However, two main elements are the link with the usual first step (market simulator) and the connection to the SCADA system (to be able to use real-time snapshots from the SCADA).

## Question 13 - Would you consider having a web interface for interacting with the planning tool?

**Summary of received feedbacks:**
Respondents agree in majority that a web interface may be used, although it is not the case for every respondent.

**Critical analysis:**
This is not critical since we develop a R&D tool for testing, so web interface will most likely be used in the Flexplan consortium.

## Question 14 - What is a realistic time that you would allow for the planning tool to run (order of magnitude)?

**Summary of received feedbacks:**
Respondents provided answers ranging from a few minutes (simple scenarios) up to 24 hours (full assessment). Some mentioned seconds. Another interesting comment is the fact that a participant mentions that if the problem may be parallelized, than the time requirement can probably be converted into a computer resources requirements, arguing also that computational power is less expensive than experts time.

**Critical analysis:**
The feedback is essential and the Flexplan consortium should aim at finding algorithms to solve the planning problems in that order of magnitude.

## Question 15 - if the model needs to be simplified to make it tractable/solvable in a reasonable amount of time, which features of the planning tool model would you simplify first?

**Summary of received feedbacks:**
Different simplifications were highlighted by different respondents, among which:

- simplify network grid (geographically, by voltage level) when possible
- use representative days instead of long time series

- simplify to steady-state analysis

However, this is difficult to decide in advance, and the user of the tool should be able to choose which simplifications he would like to perform. One respondent highlights that it is important to keep the Monte-Carlo approach for managing the probabilistic aspects of scenarios, as well as keep an integrated transmission & distribution model.

**Critical analysis:**

This feedback will be taken into account, and the planning tool will try to incorporate the possibility to let the tool user to choose which simplifications to perform or not.