UNC Workgroup 0754R Minutes
Investigate Advanced Analytic Options to improve NDM Demand Modelling
Tuesday 30 November 2021
via Microsoft Teams

Attendees,

Rebecca Hailes (Chair)	(RH)	Joint Office
Maitrayee Bhowmick-Jewkes (Secretary)	(MBJ)	Joint Office
Chris Syrett	(CS)	EON
David Mitchell	(DM)	SGN
Ellie Rogers	(ER)	Xoserve
Joseph Lloyd	(JL)	Correla on behalf of Xoserve
Dan Stenson	(DS)	British Gas
Luke Reeves	(LR)	EDF Energy
Mark Field	(MF)	Sembcorp
Mark Perry	(MP)	Correla on behalf of Xoserve
Penny Griffiths	(PGr)	Correla on behalf of Xoserve
Sarah Palmer	(SP)	E.ON
Steve Mulinganie	(SM)	Gazprom

Copies of all papers are available at: https://www.gasgovernance.co.uk/0754/301121

The Workgroup Report is due to be presented at the UNC Modification Panel by 17 November 2022.

1.0 Introduction and Status Review

Rebecca Hailes (RH) welcomed all to the Workgroup.

1.1. Approval of Minutes (05 October 2021)

The minutes from the previous meeting were approved.

1.2. Approval of Late Papers

No late papers submitted. RH thanked Xoserve.

1.3. Review of Outstanding Actions

0303: Workgroup to consider the UIG taskforce recommendations during Workgroup Development (https://www.xoserve.com/services/issue-management/unidentified-gas-uig/#task-force-findings-etc).
Update: Steve Mulinganie (SM) highlighted that this Action had remained open for a significant period of time and suggested instead it would be beneficial to cross check the UIG Taskforce's recommendations against the outputs from this Workgroup. The Workgroup considered this and agreed with the suggestion.
Mark Perry (MP) stated that the UIG findings are a reference material as they include information that is likely to be of use for the Workgroup to reach their recommendations. MP noted a link to the findings is also included in the Glossary section of the meeting slide pack presented by Xoserve and Correla.
RH suggested that the Joint Office could add a sentence to the standard Workgroup Agenda referring to the UIG Taskforce findings for ease of reference. The Workgroup accepted this suggestion and agreed the Action could be closed. **Closed.**

> **New Action 1101:** Joint Office (MBJ) to add a reference to the UIG Taskforce findings to the standard Workgroup Agenda.

1001: Joint Office (LOS) to request a 12 month extension of the Workgroup at the October UNC Modification Panel on behalf of Proposer.
Update: RH advised that this had been sought and granted, with the Workgroup to report to Panel in November 2022. **Closed.**

1002: CDSP (JL/PGr) to investigate and update the Workgroup on progress with the neural networks approach and if necessary to consider obtaining data and/or insight from the independent assessors used by the UIG Taskforce.
Update: RH noted this Action would be covered under agenda item 2.0. **Closed.**

2.0   Analysis

Penny Griffiths (PGr) highlighted that some new terms have been added to the Glossary in the meeting slide pack and added that requests to add to the Glossary can be made to Correla.

PGr provided a brief recap of the key discussion points from the previous meetings.

For a full and detailed update, please refer to the published slides on the meeting page.

Update on Area 1 Progress

Development Cycle:

PGr presented a progress update on the work done on the Development Cycle noting that further refinement of the modelling should be expected.

PGr explained that Correla have been reviewing Machine Learning Techniques, focusing on NW 01BND to test methods and understanding and then expanding to other EUCs. PGr added that the sample data from April 2017 to March 2020, excluding days effected by COVID-19 (between October 2019 to September 2020) was being used and that the favoured models were Gradient Boosted and Neural Networks as these were the recommended models from the UIG Taskforce findings.

Gradient Boosting:

PGr advised that Gradient Boosting transformed several weak learners into a strong learner to minimize training errors, clarifying that a random sample of data is selected, fitted with a model and then trained sequentially and with each iteration, the weak rules from each individual classifier are combined to form one, strong prediction rule.

PGr added that different factors needed to be considered when predicting, but fairly good results were expected from this model.

Neural Networks:

PGr explained that Neural Networks are a subset of Machine Learning, and it mimics the human brain and the way that biological neurons signal to one another by trying to work out the relationship between the different data.

PGr added that whilst the initial full Neural Network approach had not been very successful, combining a Neural Network with Generalised Linear Modelling had produced relatively good results.

Steve Mulinganie (SM) noted that this was positive news.

Jo Lloyd (JL) agreed and stated that as the Neural Networks modelling was multi-layered, it was better for classification, and it has a learning point which had been useful when

reviewing the results. JL added that the data was being tweaked in trying to reach an understanding and whilst this was not always achievable, it was still a work in progress.

Mark Fields (MF) noted that Neural Network modelling appeared to be similar to using a Black Box and asked what assurances were there that it would not produce a completely unexpected result.

JL clarified that the factors being used in the modelling were constrained and the data being tested excluded the COVID-19 period, which should remove any unexpected outcomes because of the impact of COVID-19. JL further noted that the standard review done every year on the DESC models will be an additional check on the profiles derived from this model.

JL also stated that the cycle of iterations should capture the approach for this modelling and the Workgroup would have assurances on progress being made and what output can be expected. JL advised that it would be difficult to comment on whether the work done would result in improvements made to the model as there may be unaccounted for factors such as prepayment meter profiles which may not be performing as expected, which reflected the impact of factors outside weather variables such as economic conditions on the results. However, JL noted that for the purposes of the modelling carried out here, the analysis had concentrated on the ALPs and DAFs which the industry had requested, further constraining the modelling.

MF thanked JL for explanation stating he had been part of a Profiling Taskforce in 1998 and it appears that the work carried out then had been refined and made more accurate from the analysis being presented to the Workgroup.

Dan Stenson (DS) stated that when any recommendations from this work is taken to DESC (Demand Estimation Sub-Committee), there is a likelihood it will be challenged because of using the Black Box. DS suggested (and Workgroup agreed) that it would be more beneficial to keep the work academic instead and asked what sensitive parameters were impacting the modelling.

JL advised that it was defaulting to a multilayer model which when changed to a linear model made a positive difference. JL noted there were other parameters which can also be changed if required.

Chris Syrett (CS) asked what confidence was there that post COVID-19 scenarios would reflect the pre COVID-19 data used for modelling, noting that there were always going to be factors that had not been considered in the modelling.

JL stated whole data sets had been impacted by COVID-19 and variable information can be used at different points in time of the review.

CS noted that the biggest difficulty would be to identify what the relevant criteria should be.

SM agreed with this view adding that the current models did not react well to volatility in the market as the arrangements in place were not robust enough and unless changes were made, it would mean the models would fail in the future.

DS suggested that pre and post COVID-19, it would be useful isolating special events such as Christmas periods. JL thanked DS for the insight and took the suggestion on board.

MF asked whether Correla were looking at understanding the relevance or dominance of contributory factors. PGr confirmed that they were. JL added that one of the things they were looking at included a seasonal variable on temperature noting that CWV was one of the biggest influences on the modelling.

JL further advised that they were trying not to constrain the data by challenging the methodology and also in order to gain confidence in the work being done.

JL noted that the current work on the EUCs is refining the methodology and this will soon be expanded and the results being seen on the Gradient Boosting modelling is expected to be seen in the Neural Networks as well.

SM noted that the Review Workgroup was created to ask questions and agreed that different approaches may be effective as the data presented was showing. JL agreed with this view.

Model Verification:

PGr explained that the initial results were based on a default optimisation approach and after investigation, a number of alternatives were identified.

Out of these the Generalised Linear Model has worked well. PGr noted this was not the only technique used as it did not take into account factors such as seasons, month, day of the week , holidays etc.

PGr added that whilst trying to improve a model, it was important to consider what 'normal' looked like, noting that the previous modelling presented to the Workgroup had been quite erratic and it had been apparent that forecasting should not look like that, and this has now been addressed.

Model Development

Neural Networks:

PGr presented a chart showing the ALP results from the Neural Network Machine learning using the Generalised Linear Modelling method, which has produced a much smoother ALP than the Gradient Boosting method with fewer unusual spikes, noting that putting more demand in winter weekends has been positive.

 JL added that three years of data had been added to the model without any refinement and this may result in some profiles being slightly disjointed.

DAF calculations:

PGr presented the DAF calculations noting this related to Action 1002, explaining that the weather sensitivity has been calculated using the machine learning output for Seasonal Normal CWV compared to actual CWV in a similar way to the current methodology and the DAF algorithm has not been changed.

PGr presented a worked example of the calculations, noting that the summer values show a clear difference in the DAF for weekends and potentially days with a holiday code, which will be investigated.

MF noted that the calculations factored over winter appears to be more accurate than summer.

PGr presented the calculation of DAF from Gradient Boosted data and for Neural Networks, noting that the calculated DAF had a similar shape to the live DAF, however the live DAF had slightly better shape to the summer months.

As with the ALP calculation, PGr advised, there was a lot more noise in the Gradient Boosted DAF calculation, which the Neural Network machine learning methodology has been able to remove. PGr added that live DAF had also been adjusted for new seasonal normal.

PGr also presented the results from using Machine Learning to calculate the WSENS and DAF values, noting that the shape of the results was promising, and a fairly good output was expected.

SM asked if the expectation was that some of the problems highlighted would be reduced, specially over summer months where the curve is quite steep. JL advised that this would be addressed as much as possible.

CS asked whether the steps being highlighted were unique to NW 01BND. PGr explained the steps were highlighted in the DAF calculations slides, adding that these have not yet been tested against other EUCs but the sample size was quite big.

DS suggested that when using categorical variables in regression modelling, it was more likely to be successful when running combining models. PGr took this suggestion on board.

<u>Verifying Output</u>

<u>ALP and DAF Profiles:</u>

JL presented the ALP and DAF profiles for different EUCs to demonstrate the impacts. These include views of the Gradient Boosting and Neural Network models.

JL explained that the charts showed:

- A consistency in the ALP profile between current modelling approach and the alternatives.

- The DAF is showing some variation, the full impact of this will be clearer once we review the modelling error in the Test Cycle phase.

JL added that that next step would be for a deeper dive into these results to identify more details and where they were performing well and whether the behaviour of the different models could be differentiated.

A number of learnings from the outputs so far were also highlighted:

- Weather sensitivity can be identified.

- Gradient Boosting between some modelling can be identified.

- The levels between the Neural Network and Live DAF/ALP can be identified.

- The weekend and holiday effects are being picked up with ALPs for some EUCs more than others.

- Some additional work is required for DAFs.

JL advised that there were still some quirks that cannot be explained but added that it was hoped that breaking down the modelling into summer and winter will result in better understanding.

SM noted these were all initial findings and suggested it would be beneficial to wait to conclude any results. JL agreed with this view and said that the aim was to not make any assumptions.

SM asked whether the Indicative Load Factor in the Black Box was part of the development cycle. JL explained that this had not yet been ascertained and there was usually some deviation between the results from the different models.

<u>Test Cycle</u>

<u>Test Modelling Error:</u>

JL advised that testing the modelling error involved assessing the ALP and DAFs against sample data and using the datasets collected for DESC's Algorithm Performance, and the ALPs and DAFs are fed into the system which carries out the comparison.

JL also presented the MAPE (Mean Absolute Percentage Error) Comparison for different EUCs, noting there had been some encouraging results from this testing. JL explained this was the raw data which required further refinement and it will be further reviewed and compared.

JL stated that Correla will also be looking at what qualities of the Neural Network can be applied to other modelling and which variables are key.

SM noted that it appeared that the outcomes of the modelling carried out so far had been quite positive.

JL agreed and advised that further factors are still being reviewed such as weather differences or the impact of COVID-19 impacted months.

DS stated that for Neural Networks more variations are required, which needs more iterations to be run before an accurate baseline can be reached. DS suggested allowing the modelling to have a longer runtime. JL accepted this suggestion.

The Workgroup agreed that it appeared that good progress had been made so far and the analysis and testing shared with the Workgroup in this meeting showed that there was value in continuing the work.

Conclusions:

JL presented the conclusions noting:

- Progress was being made, particularly with calculating ALPs and DAFs and good results had been achieved with the Neural Networks as well.
- The results showed similarity to the live model although further refinements will still be required, including tweaking the methodology used.
- Suggestions made by DS will be considered.

3.0   Approach Document

This was captured in section 2.0.

4.0   Model Development

This was captured in section 2.0.

5.0   Next Steps

JL noted, the focus of the next Workgroup would be on:

- Deep diving into the output to see areas of success and areas for improvement, e.g. looking at individual months, weekdays, holiday codes;
- Complete refinement of models for trial LDZs;
- Calculation of Indicative Load Factors (ILF).

JL briefly presented the timeline for the Workgroup. SM asked with the Workgroup extension until November 2022 in place it may be worth holding the next meeting in January 2022.

MP agreed pointing out that a standard DESC meeting was due to be held in December 2021 and it would be beneficial to postpone this Workgroup until January.

RH suggested the Joint Office could discuss the next meeting date with Correla offline. MP agreed with this suggestion.

6.0   Any Other Business

SM highlighted that the meeting slide pack was marked as being presented by Correla and Xoserve. SM noted that for IP rights, it was necessary to establish that any recommendations and output from this Workgroup, remains within the Workgroup and Xoserve. Whilst Correla are working under contract with Xoserve, there is need for clarity around the IP rights for their relationship.

ER noted that she would review this internally and revert to the Workgroup with a statement or explanation.

New Action 1102: Xoserve (ER) to review the IP rights of the work done for this Workgroup and confirm this belonged to Xoserve.

7.0   Diary Planning

Further details of planned meetings are available at: www.gasgovernance.co.uk/events-calendar/month

Workgroup meetings will take place as follows:

Time / Date	Venue	Programme
10.00 am Tuesday 25 January 2022	TBC	TBC
10.00 am Thursday 22 March 2022	TBC	TBC

Action Table (as at 30 November 2021)

Action Ref	Meeting Date	Minute Ref	Action	Owner	Target Date	Status Update
0303	23/03/21	3.0	Workgroup to consider the UIG taskforce recommendations during Workgroup Development (https://www.xoserve.com/services/issue-management/unidentified-gas-uig/#task-force-findings-etc).	All	Ongoing Requirement	**Closed**
1001	05/10/21	1.4	Joint Office (LOS) to request a 12 month extension of the Workgroup at the October UNC Modification Panel on behalf of Proposer.	Joint Office (LOS)	November 2021	**Closed**
1002	05/10/21	2.0	CDSP (JL/MP) to investigate and update the Workgroup on progress with the neural networks approach and if necessary to consider obtaining data and/or insight from the independent assessors used by the UIG Taskforce.	CDSP (JL/MP)	November 2021	**Closed**
1101	30/11/21	1.3	Joint Office (MBJ) to add a reference to the UIG Taskforce findings to the Workgroup Agenda.	Joint Office (MBJ)	Next Workgroup	**Pending**
1102	30/11/21	6.0	Xoserve (ER) to review the IP rights of the work done for this Workgroup and confirm this belonged to Xoserve.	Xoserve (ER)	Next Workgroup	**Pending**