1 DiBoss and TPO Team Decisions

1. 2000 original timestamps, which were culled down to 400 of what Ashish thought were the most useful.
2. Then, the building operators/engineers decided which points among those were the most import
3. The BMS has many outages, which results in a string of 0's in the time-series
4. Data integrity issues:
   (a) system shutdowns
   (b) data spikes resulting in output $>> 1$
   (c) repeating (sticky) values
5. bad data is filtered by TPO, and filled via linear interpolation < 2 hours on the fly
6. when TPO is not getting on-the-fly data, it sends the same data over and over again to the DiBoss front-end
7. Selex contract for DiBoss ends June 30.

2 Columbia/Engineers/John/Neal Meeting 10/2/2015

1. Rampdown happens itself, via BMS
2. Engineers interested primarily in start-up time forecasting and occupancy forecasting
3. Rampdown occurs at $4:00$pm by default at the latest–the system will pick up on the time people are leaving, and ramp down automatically
4. Occupancy forecasts are, hence, more for the engineers and manual operations
5. The BMS for 560 Lexington has sensors that measure pressure on air ducts (VFD), which signal for fans to slow down (hardware, instantaneous calibration–this will beat any statistical forecast, which has, no matter how refined, some noise. Over time, noise will cancel itself out, but for short times, definitely not. As a result, building costs will be

incurred in the beginning phases of an installation of the new DiBoss. Hence, VFD looks like a good idea–can avoid this initial noise cost by investing in cheap hardware)

6. BMS regulates interior space temperature–so, as long as start time is good, we're good (Gene Boniberger). Space temperature by sector–so we backwards iterate from sector with highest temperature at first inflection point, in order to determine start-up time for whole building. Later, can refine so that we have start-up times for each sector, by backwards iterating from their individual time-series

7. However, fan adjustments are not automated in some buildings–some may not have VFDs

8. However, VFDs can always be installed–the real issue is whether the VFDs are linked via BMS to the occupancy (Gene)

9. In the winter months, 6am to 11am is monitored for steam emissions–anything above a certain threshold, and Rudin gets an excessive charge. Hence, an additional cost function must be provided to the TPO model in the winter months. However, this is just an edge case, and can be dealt with once we already have a beta of the product

10. For fan speed, we can assume 100% instantaneous speed for the fans once they are started up. Some buildings do have fans that can be operated at a fraction of full capacity, but Gene is looking to just blast all fans in a building once start-up is initiated. He'd rather just calibrate the actual start-up time, which makes much more sense to me–one start up time vs. multiple fans. This is a less-prone-to-error approach

11. Gene will provide a temperature chart for start-up, to help forecast start-up time. This is KEY. More precisely, we will be able to answer the following question: how many minutes did it take to get to an inflection point in interior space temperature for a given ramp-up time, with outside air temperature equal to X?

12. Startup=startup of fans

13. People who worked on TPO2: 6 full-time equivalent people (60+ hours a week)

14. Included Ashish, Albert, Roger, and Leon (all full-time)

15. Total number of employees, full-time and not, was 12.

3 Columbia Server Information

1. VPN ID: remote Pass: easyaccess
2. Remote Desktop ID: ColumbiaAdmin Pass: ColumbiaPassword00
3. Cisco IPSEC VPN ID: as.aboulanger.com ServerName: rudin.aboulanger.com
4. SVN ID: AlbertBoulanger Pass: sk8sk8 Server: `https://power.ldeo.columbia.edu/svn/Proj/SmartGrid`

4 TPO3

1. Hidden Markov Chain implemented by Hooshmand (Biogenetics dept.)
2. Random Forest Regression implemented by Hooshmand
3. Ashish's goto expert for statstical questions was Lauren Hanna

5 Meeting With Lawyers 06/29/2015

1. What is exclusive ownership of TPO worth?
2. What can we use in DiBoss that we do not have an inventorship claim to?
3. Ideal situation is to just have a clean story–may alone make purchasing TPO worthwhile
4. Columbia is getting inquiries from 3rd parties
5. Decision by lawyers at meeting is to pursue deal to gain access to software and have own the name "DiBoss".
6. Deal with Columbia would be based on royalties

6 Elevators

1. Elevators–don't have Selex involvement
2. Each car has 150 data points

3. When it gets to the threshold of number of warnings, the car goes into maintenance mode

4. Company gets notified only when the elevator turns off (not good, company should be notified, along with engineers, when warning threshold is approached or attained)

5. Gene wants a tab on the front-end displaying elevator data with *all* warnings

7 John's Questions After Return from Italy

1. Have you seen the DiBoss source code?

2. Are you comfortable with the source code?

3. Are you confident in the support Selex can provide for the system, even if it is minimal?

4. Are you confident in the transfer process of the DiBoss product? Of the source code?

8 Things to Do Differently (Gene)

1. Plot scaling is often terrible (due to outlier values). Solution on analytics end: filter out outliers before plotting, and offer user option to view the outliers in a separate plot

2. Currently, there is a mislabeling of temperatures, sensors, and titles for plots. 6 measurements for the chiller, when only 4 are needed by the engineers.

3. Predict startup-time accurately. *Most Important*

4. For electric, give a benchmark of best usage, vs. today

5. Include line with peak usage of electricity, since there is a penalty Rudin is assessed by Con-Edison for electricity usage above a certain threshold

6. Lease contract states that system ramp-up must be by 8:00 am (for some buildings, it is 7:00). For example–345 Park: 7, 40 East: 7, 80 Pine: 24/7 on, 1 Battery Park: Monday-Friday, 8:00am-1:00am

9 TPO3

1. HVAC optimization problem. TPO3 is an *optimizer*
2. TPO2 provided forecasts for steam, electricity, etc and recommended a startup time and ramp down time based on a posteriori observations (for example, operator behavior in the past)
3. TPO3 changed things up. No longer depends on past operator behavior, like TPO2. Based on optimization instead. Instead, it has its own forecaster, the heart of which is an objective function with arguments *temperature violations* and *energy costs*
4. TPO3 is currently running at 345 Park
5. Training data comes from past operator usage, but forecasts don't care about operator actions in present (uh, why should they–SVM and ARMA type models operate in a similar fashion)
6. Trying to predict next state (can use Viterbi, but this is just ARMA type with a bit more complexity, perhaps unneeded complexity)
7. State vectors include VPT frequencies
8. Hooshmand currently looking into SAX for anomaly detection via discretization and clustering. (Cousin to Haar wavelets)
9. Wanted three months of funding to look at other approaches for anomaly detection

10 Scrum 10/05

1. Unless turnstiles are at the bank level, won't know which sector of building people are going to based on turnstiles.
2. 32, 80 Pine are some of those where turnstiles DO tell us which sector of building people are headed to, which will be critical for interior space temperature predictions via occupancy)
3. Some turnstiles only have "In", not an "Out"–they're just gates with an "open" and "closed" switched
4. have access to Mongo University (on Rudin's dime)