# Notre Dame WBB

# Travel Stress Quantification

Grow Irish 2025

12/12/25

Drew Berkland, Bangni Chen, Jimmy Thomas, Carlos Padilla

# Problem Motivation

## The Project

Create a data-driven system to quantifying the effects of travel on team performance

## Goal

Develop a data-driven metric using publicly available data to quantify travel load and evaluate its impact on performance, recovery, and scheduling decisions

# Agenda

- Problem Overview
- Travel Stress Score Creation
- Impact of TSS on Performance Metrics
- Predictive Power of TSS
- Recommendations

# Project Steps

1. Design a Travel Stress Score (TSS)
2. Test How TSS Influences Performance Metrics
3. Model TSS to Predict Future Pain Points
4. Generate Recommendations for Future Seasons

# Travel Stres Score Creation

# TSS Factors

- Travel Time
- Days Since Last Game
- Opponent Rank
- Away Game Streak
- Time Zone Change

# Primary Travel Stress Factors

### Travel Minutes

- Longer travel = higher physiological and logistical stress

### Opponent Strength

- Stronger opponent = higher stress

### Rest Days

- Shorter rest: higher physiological and recovery demand
- Excluded long breaks (>50 days) to avoid off-season distortion

### Road Game Indicator (Home vs Away)

- Away environments increase disruption and pressure

### Time Zone Change

- Captures circadian disruption; even small changes can affect recovery

### Back-to-Back Games

- Games played on consecutive days; highest acute-stress situation

# Deriving Weights

OLS Regression Results

| | | | |
|---|---|---|---|
| Dep. Variable: | margin | R-squared: | 0.128 |
| Model: | OLS | Adj. R-squared: | 0.102 |
| Method: | Least Squares | F-statistic: | 4.887 |
| Date: | Thu, 11 Dec 2025 | Prob (F-statistic): | 4.56e-07 |
| Time: | 16:19:24 | Log-Likelihood: | -1618.0 |
| No. Observations: | 378 | AIC: | 3260. |
| Df Residuals: | 366 | BIC: | 3307. |
| Df Model: | 11 | | |
| Covariance Type: | nonrobust | | |

| | coef | std err | t | P>\|t\| | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| const | 15.7646 | 0.914 | 17.247 | 0.000 | 13.967 | 17.562 |
| travel_minutes | -3.5017 | 1.263 | -2.773 | 0.006 | -5.985 | -1.019 |
| opp_rank_stress | 2.3905 | 1.786 | 1.338 | 0.182 | -1.122 | 5.903 |
| days_stress | -0.0344 | 0.949 | -0.036 | 0.971 | -1.901 | 1.833 |
| road_score | -3.8483 | 1.150 | -3.348 | 0.001 | -6.109 | -1.588 |
| timezone_change | 0.0942 | 0.680 | 0.139 | 0.890 | -1.243 | 1.432 |
| back_to_back | 1.0710 | 0.964 | 1.111 | 0.267 | -0.824 | 2.966 |
| travel_minutes_x_opp_rank_stress | 6.3874 | 2.474 | 2.582 | 0.010 | 1.523 | 11.251 |
| travel_minutes_x_days_stress | -0.1471 | 1.823 | -0.081 | 0.936 | -3.732 | 3.438 |
| travel_minutes_x_road_score | -3.0022 | 1.272 | -2.359 | 0.019 | -5.505 | -0.500 |
| travel_minutes_x_timezone_change | 4.6767 | 1.916 | 2.441 | 0.015 | 0.909 | 8.444 |
| opp_rank_stress_x_days_stress | 1.6226 | 0.990 | 1.640 | 0.102 | -0.323 | 3.569 |
| opp_rank_stress_x_road_score | -8.1589 | 2.456 | -3.323 | 0.001 | -12.988 | -3.330 |
| opp_rank_stress_x_timezone_change | -1.3868 | 1.586 | -0.874 | 0.382 | -4.506 | 1.732 |
| days_stress_x_road_score | 0.8131 | 0.895 | 0.908 | 0.364 | -0.947 | 2.574 |
| days_stress_x_timezone_change | -1.7172 | 1.241 | -1.384 | 0.167 | -4.157 | 0.722 |
| road_score_x_timezone_change | 2.6767 | 1.666 | 1.606 | 0.109 | -0.600 | 5.954 |

| | | | |
|---|---|---|---|
| Omnibus: | 5.574 | Durbin-Watson: | 1.555 |
| Prob(Omnibus): | 0.062 | Jarque-Bera (JB): | 5.665 |
| Skew: | 0.218 | Prob(JB): | 0.0589 |
| Kurtosis: | 3.412 | Cond. No. | 2.37e+16 |

**Derived Weights for Primary Terms:**

| | |
|---|---|
| travel_minutes | 0.084320 |
| opp_rank_stress | 0.057563 |
| days_stress | 0.000828 |
| road_score | 0.092666 |
| timezone_change | 0.002268 |
| back_to_back | 0.025790 |

**Derived Weights for Interaction Terms:**

| | |
|---|---|
| travel_minutes_x_opp_rank_stress | 0.153805 |
| travel_minutes_x_days_stress | 0.003542 |
| travel_minutes_x_road_score | 0.072293 |
| travel_minutes_x_timezone_change | 0.112612 |
| opp_rank_stress_x_days_stress | 0.039072 |

# Final TSS Formula

**TSS = Weighted Primary Stress + Weighted Interaction Stress**

OLS Regression Results

| | | | |
|---|---|---|---|
| Dep. Variable: | weighted_TSS_full | R-squared: | 0.875 |
| Model: | OLS | Adj. R-squared: | 0.873 |
| Method: | Least Squares | F-statistic: | 431.8 |
| Date: | Thu, 11 Dec 2025 | Prob (F-statistic): | 5.84e-164 |
| Time: | 16:54:41 | Log-Likelihood: | -180.30 |
| No. Observations: | 378 | AIC: | 374.6 |
| Df Residuals: | 371 | BIC: | 402.1 |
| Df Model: | 6 | | |
| Covariance Type: | nonrobust | | |

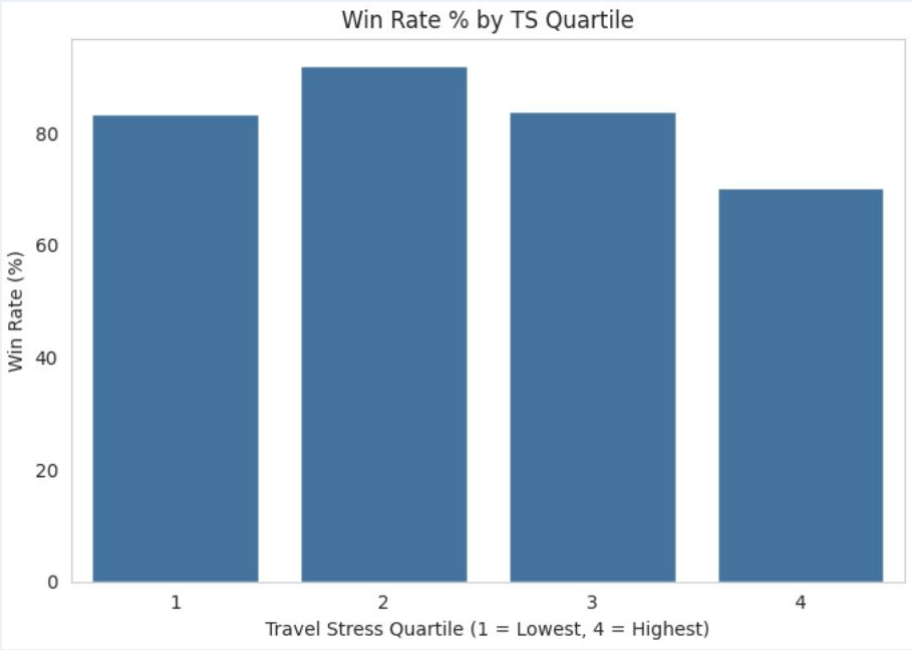
| | coef | std err | t | P>\|t\| | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| Intercept | -0.8457 | 0.027 | -30.897 | 0.000 | -0.900 | -0.792 |
| distance_miles | 0.0002 | 0.000 | 1.037 | 0.300 | -0.000 | 0.001 |
| travel_minutes | 0.0027 | 0.001 | 2.236 | 0.026 | 0.000 | 0.005 |
| days_since_last_game | 0.0007 | 0.001 | 1.185 | 0.237 | -0.000 | 0.002 |
| road_score | 1.9747 | 0.403 | 4.905 | 0.000 | 1.183 | 2.766 |
| timezone_change | -0.2319 | 0.395 | -0.587 | 0.558 | -1.009 | 0.545 |
| back_to_back | 0.0426 | 0.080 | 0.530 | 0.596 | -0.115 | 0.201 |

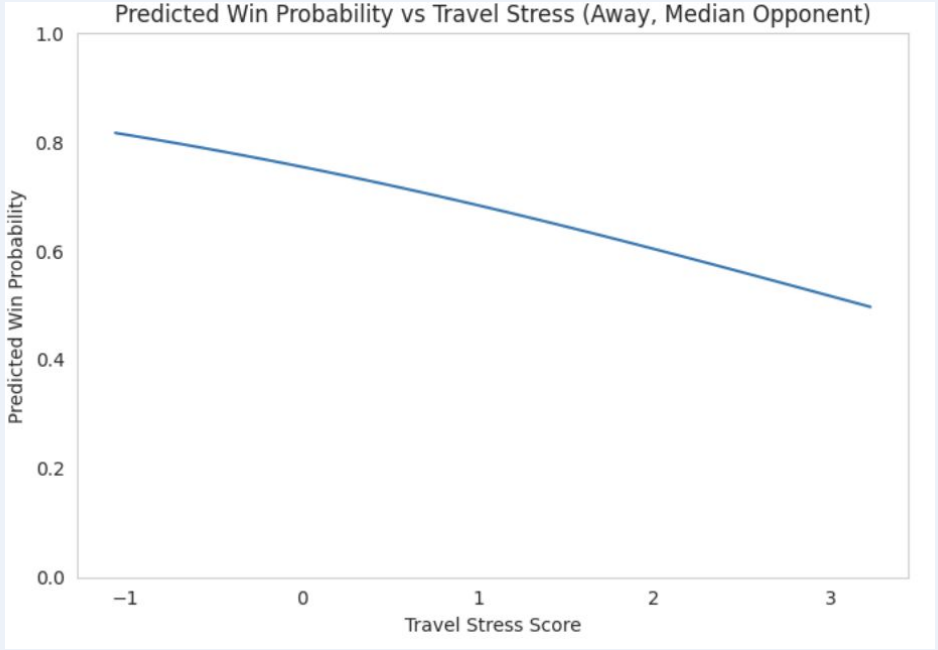
| | | | |
|---|---|---|---|
| Omnibus: | 87.182 | Durbin-Watson: | 1.979 |
| Prob(Omnibus): | 0.000 | Jarque-Bera (JB): | 2215.905 |
| Skew: | -0.134 | Prob(JB): | 0.00 |
| Kurtosis: | 14.858 | Cond. No. | 1.15e+04 |

# Impact of TSS on Performance Metrics

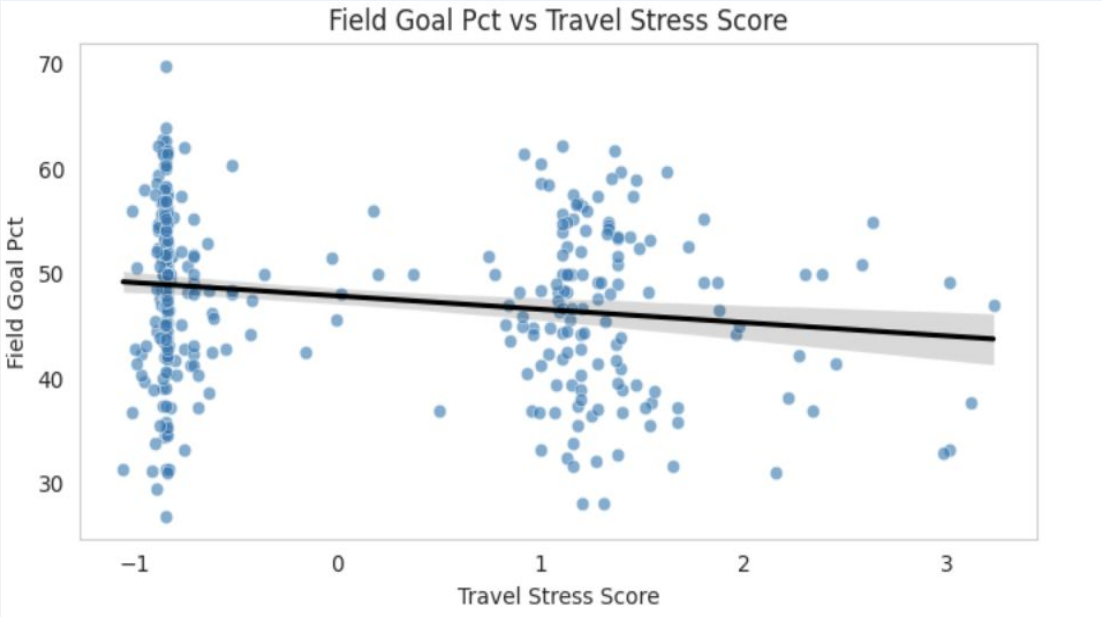
Impact of TSS on Performance Metrics

# Winning Percentage



# Field Goal Percentage

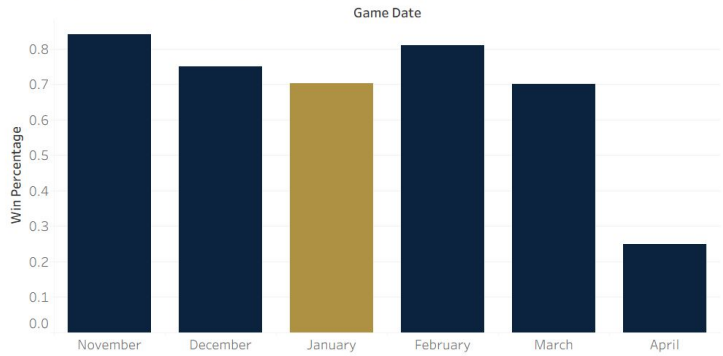


Impact of TSS on Performance Metrics

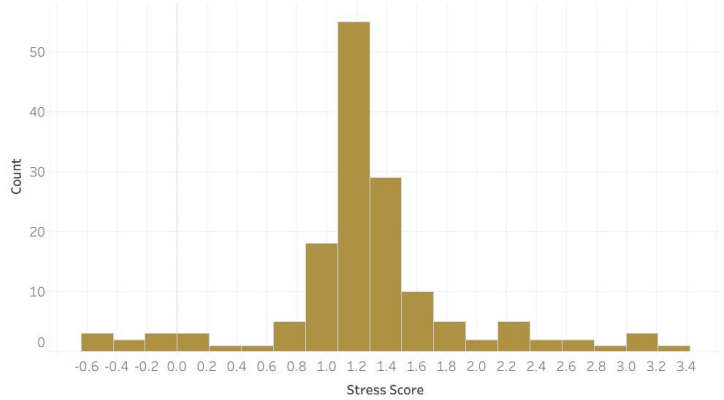
# High Level Statistics

Average Stress Score by Month

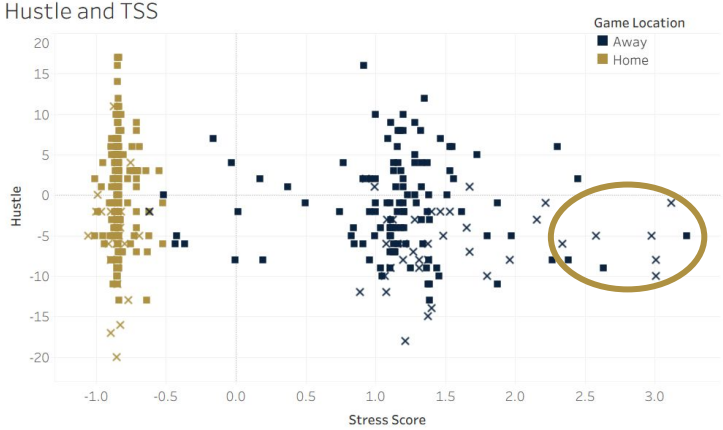

Road Win Percentage by Month




Distribution of Stress for Away Games




Hustle and TSS



# Predictive Power of TSS

# Bagging: Margin Prediction

```
# Main travel & schedule features + TSS
base_features = [
    "rest_score",
    "road_score",
    "timezone_change",
    "days_since_last_game",
    "distance_miles",
    "travel_minutes",
    "opp_rank_stress",
    "days_stress",
    "back_to_back",
    "travel_stress_score",
    "weighted_TSS_full"
]
```

Test $R^2$: **0.268**
Test RMSE: **12.886**

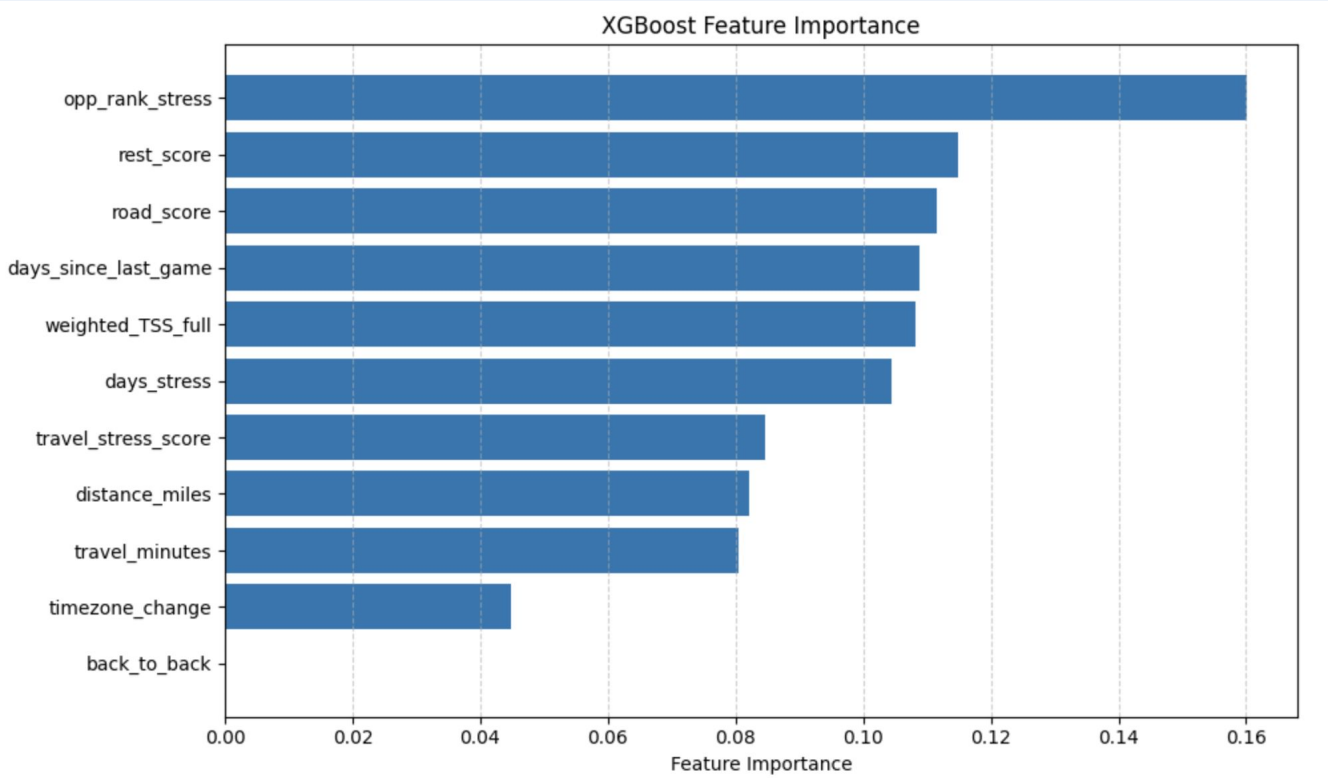
Indicates **limited predictive power** for game-level margin

Travel variables alone cannot fully predict scoring outcomes

Margin is noisy and influenced by many non-travel factors

Bagging serves as a weak **baseline** for comparison

# XGBoost: Win Prediction




Test Accuracy: **0.759**

Test AUC: **0.717**

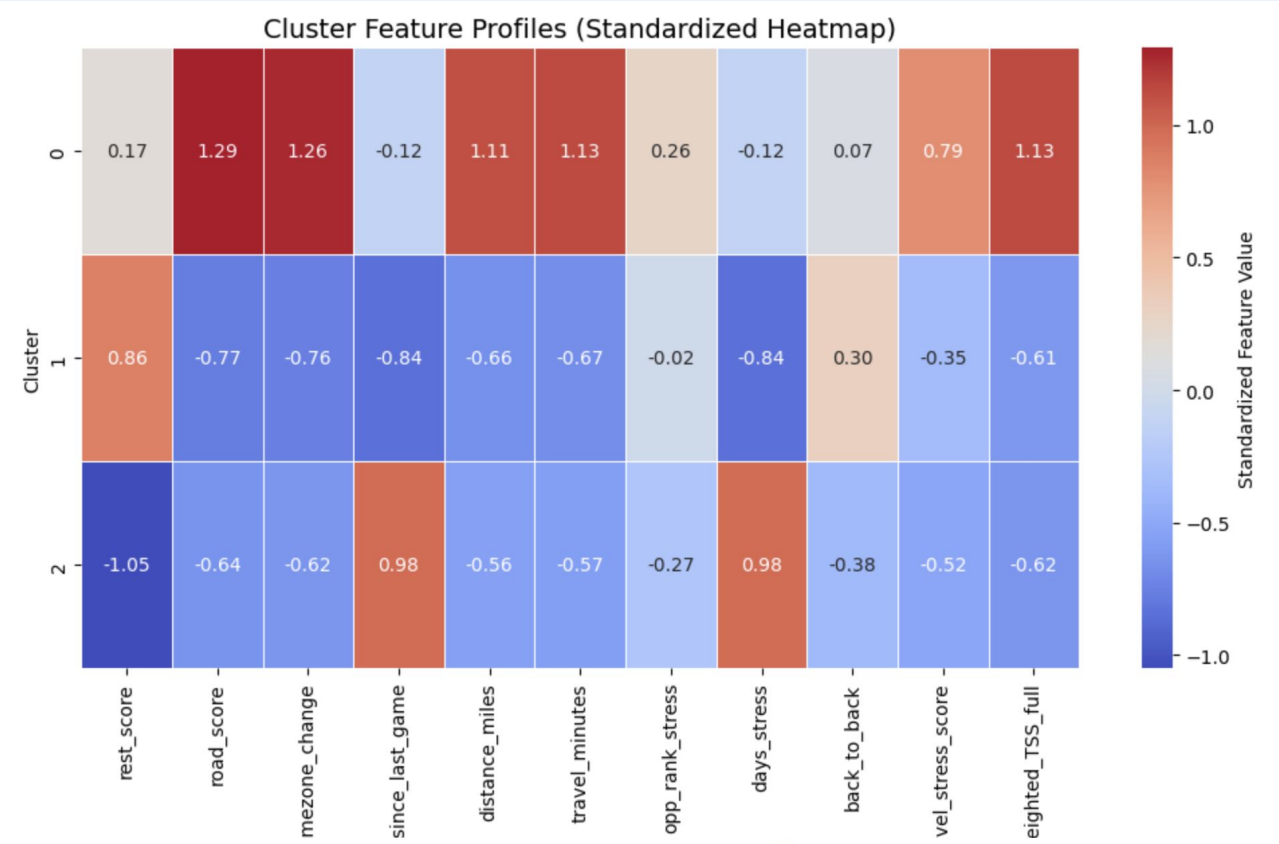
Key predictors:

**Opponent Rank Stress** (strongest)

**Rest Score**, **Road Score**, **Days Since Last Game**

**Travel Stress Score**

# Clustering: Travel Stress Profiles




**Cluster 0:** High-travel stress: worst win rate

**Cluster 1:** Home/low travel: best margin and win rate

**Cluster 2:** Short travel but schedule congestion: moderate performance

# Recommendations

Recommendations

# Logistics & Planning

## Use TSS as a Planning Tool for Schedule Design

Identify games/stretches in Q3–Q4

Build schedules that reduce clustered travel

## Adjust Travel Timing Based on Stress Level

For high-TSS, travel earlier

Two-day early departures

Recommendations

# Coaches & Strategy

## Adjust Practices by TSS Quartile

Less intense practices

Allows players acclimatation

## Increase Bench Utilization

Higher substitutions in Q3-Q4 games

Counter fatigue-related declines

## Provide Coaches with TSS Data

TSS used by all staff

Game plan continuity