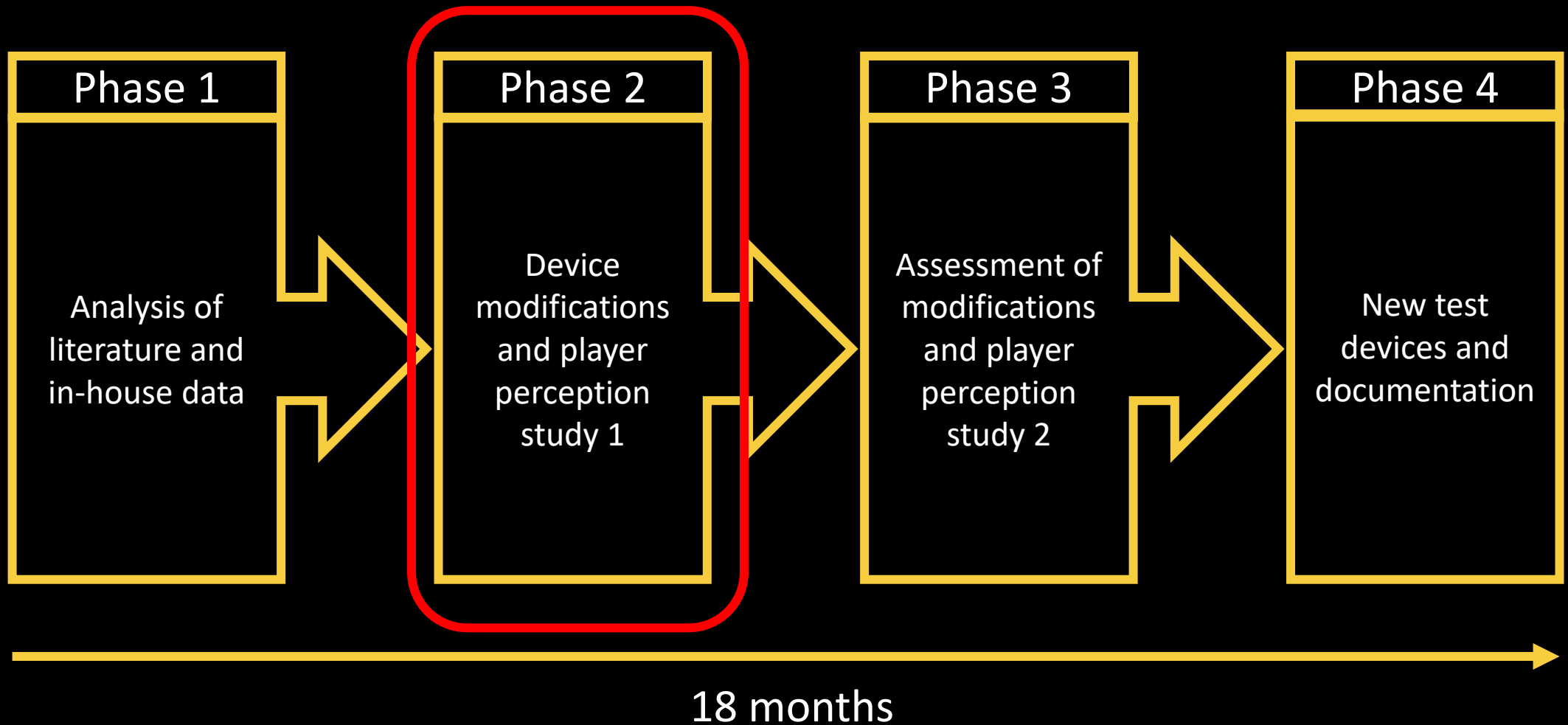


ADVANCED TURF MEASUREMENT FOR PLAYER SAFETY & PERFORMANCE

To develop a new test device and method to measure the typical player–surface interaction in the game of football that correlates with the player’s perception of the surface.

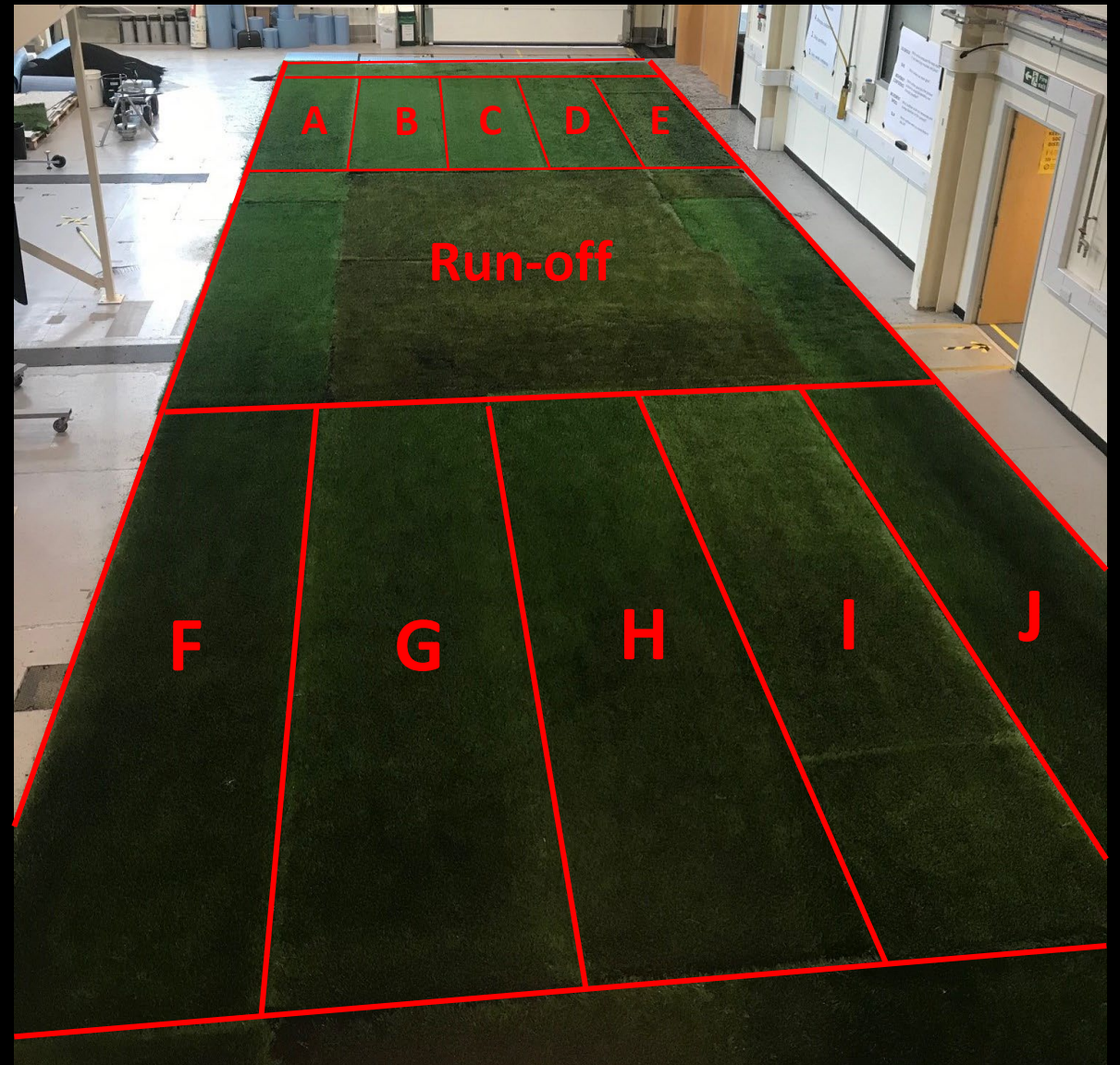


Project overview



Perception study – Set up

- Test area 18 m long × 6 m wide consisting of 10 test areas (5 m long × 1.2 m wide).
- Five had hardness manipulated through the shockpad (SA 61% - 74%) and a consistent traction (~45 N.m).
- Five had traction manipulated through SBR size range, sand/rubber mix and carpet (Tpk 35 – 48 Nm) and a consistent hardness (~75%).
- 11 M & 9 F from LU 1st / 2nd teams complete pairwise comparisons of test areas.



Perception study – Protocol

- Three step trained panel approach:
 1. **Panel selection** – identify which players are discriminant and repeatable.
 2. **Training** – ensure all players are interpreting attributes and movements in the same way.
 3. **Evaluation** - evaluate the reliable player responses against the mechanical test devices (standard and modified).
- Modifications to mechanical devices informed by literature:

RTT

- Full torque-angle profile
- Increased/Decreased normal load
- Dimpled test foot

AAA

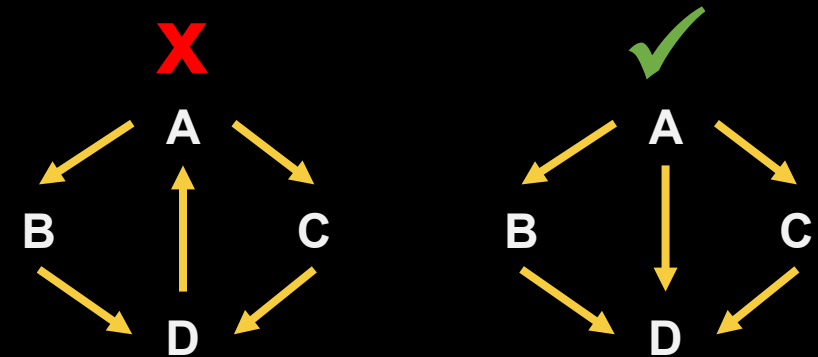
- Full impact acceleration profile
- Increased drop height
- Increased test foot area



Analysis - Perception data

- Language developed with players over several focus groups prior to study.
- Key attributes identified:
 - **Hardness:** Leg shock, Give
 - **Traction:** Movement confidence, Movement speed, Slip
- Assessment of perception data:
 - **Intra-player consistency** - Did the players conflict themselves with their rankings?
 - **Inter-player agreement** - Did the players rank the surfaces in the same order?

For surfaces A, B, C and D
Intra-player consistency

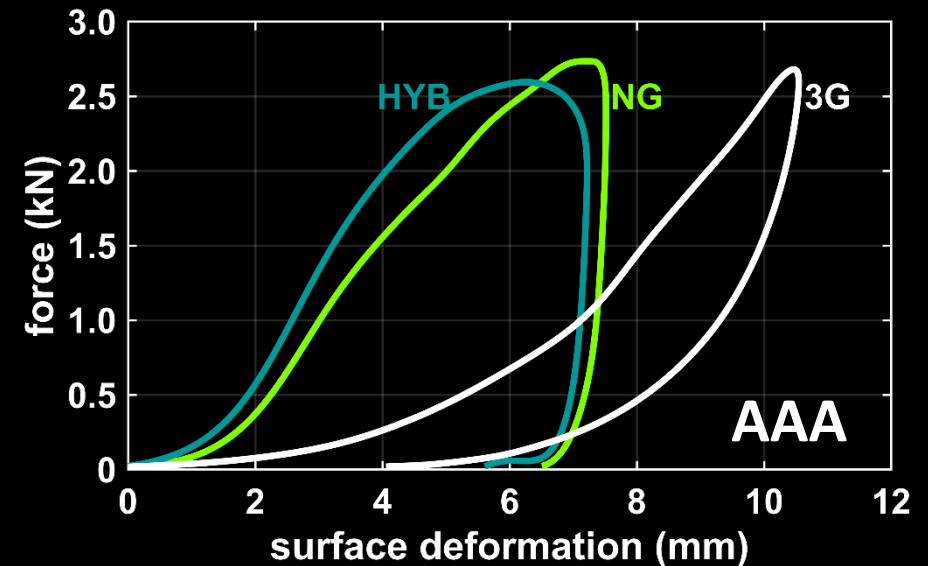
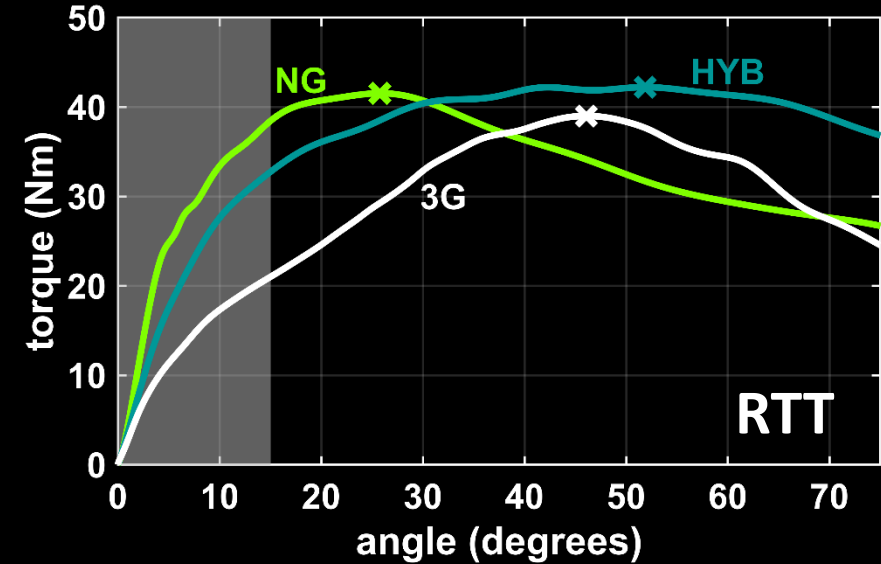


Inter-player Agreement

| | Subject 1 | Subject 2 | Subject 3 | Subject n... |
|-------|-----------|-----------|-----------|--------------|
| Most | A | A | B | A |
| | B | B | A | B |
| | D | C | C | D |
| Least | C | D | D | C |

Analysis - Mechanical data

- RTT and AAA data collected to FIFA standard specification and with device modifications.
- Differences in the surfaces with respect to:
 - **RTT:**
 - Peak torque, angle of peak torque, stiffness (N.m/°), etc.
 - **AAA:**
 - Shock absorption, energy restitution & vertical deformation
 - Analysis of each drop and average of drops 2&3.
 - New calculation methods for energy restitution and vertical deformation.



Perception vs Mechanical data

- **Perception data:**

- Which attributes produced the strongest agreement between players?
- What were the smallest identifiable differences in hardness and traction?

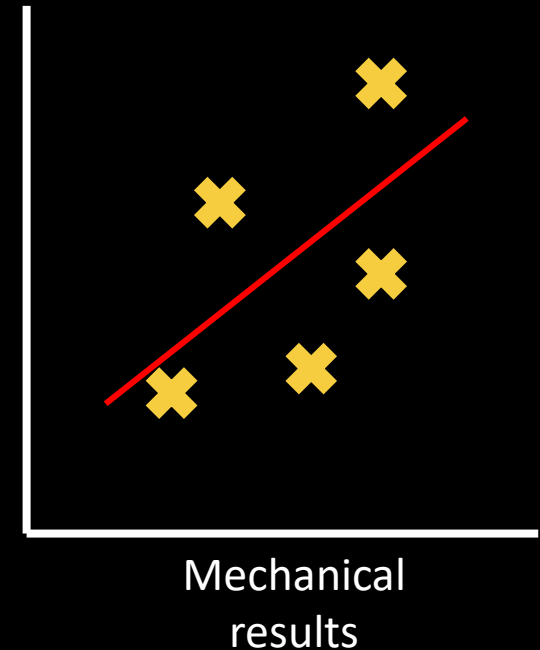
- **Mechanical data:**

- What effect did the device modifications make to the measured surface properties?

Assessment of the correlation between players perception of surfaces against measured mechanical surface response



Player perception results



Implications to industry

- **Changes (hardware and data processing) to the RTT and AAA** based upon which modifications/measurements show greatest correlation to player perception data.
- Greater understanding of **what changes to surface properties players can identify** and **what conditions they favour**.
- **Development of a language** relatable to players to make it easier to compare surface properties in future perception based studies.

Questions?



Surfaces and Mechanical Testing

- Create surfaces with controlled hardness and traction properties
- Complete standard and modified testing on these surfaces

| | | | | | |
|-----------------|----|----|----|----|----|
| | | | | | |
| SA (%) | 74 | 70 | 71 | 68 | 61 |
| | | | | | |
| Tpk (Nm) | 50 | 44 | 47 | 49 | 48 |
| | | | | | |

Five surfaces of varying hardness

(2nd and 3rd are the same)

| | | | | | |
|-----------------|----|----|----|----|----|
| | | | | | |
| SA (%) | 75 | 62 | 76 | 76 | 75 |
| | | | | | |
| Tpk (Nm) | 35 | 47 | 42 | 40 | 48 |
| | | | | | |

Five surfaces of varying traction

(3rd and 4th are the same)

Surfaces and Mechanical Testing

- Create surfaces with controlled hardness and traction properties
- Complete standard and modified testing on these surfaces

| | | | | |
|---------|---------------------|---------|----------------------|---------|
| Run off | 1. 77% 35 N.m | Run off | 6. 61% 47 N.m | Run off |
| | 2. 78% 42 N.m | | 7. 63% 45 N.m | |
| | 3. 72% 48 N.m | | 8. 77% 52 N.m | |
| | 4. 69% 48 N.m | | 9. 76% 51 N.m | |
| | 5. 77% 39 N.m | | 10. 72% 49 N.m | |

Five surfaces of varying
Hardness

(3 and 10 are the same)

Five surfaces of varying
Traction

(2 and 5 are the same)