5-Step Metrics Selection Process

Step 1

- Determined top non-null and non-blank metrics in the dataset from the three devices (Vald, Hawkins, Kenixon).

- Mapped these to key sports performance and injury risk concepts using the framework (*Table 1*)

Table 1

Performance Concept	Vald Metrics	Hawkins Metrics	Kenixon Metrics	Interpretation & Use
Player Load (External Workload)	N/A	N/A	accel_load_accum, accel_load_accum_avg_per _minute, event_count_exertion, event_count_exertion_avg_ per_minute	Kenixon provides clear workload quantification via acceleration load and exertion event counts, key for fatigue and injury risk monitoring.
Rate of Force Development (RFD)	N/A	Avg. Propulsive Force(N), Peak Propulsive Force(N), Avg. Propulsive Power(W), **Peak Propulsive Power(W) mRSI (m/s)**[1]	N/A	Hawkins provides direct force and power metrics related to **explosive strength and neuromuscular function relevant to injury risk and performance.**

Impulse (Force × Time)	N/A	Propulsive Net Impulse (N.s), Relative Propulsive Net Impulse (N.s/kg), Positive Net Impulse (N.s), Braking Net Impulse (N.s)	N/A	Hawkins impulse metrics indicate force application over time during activities, useful for biomechanics and injury analysis.
Acute:Chronic Workload Ratio (ACWR)	N/A	N/A	Event_count_exertion_category_avg_per_minute (categories 1-7), accel_load_accum_avg_per_minute	Kenixon's exertion event counts and accumulative load over time can be used to derive acute vs chronic workload ratios for injury risk prediction.
Movement Efficiency / Gait Complexity (ME&GC)	**Jump Height (m)**[2]	**Peak Velocity (m/s),** Takeoff Velocity (m/s), Braking Phase(s), Braking Phase %	**Speed_max (m),** speed_avg, **distance_total (m),** speed_distance_per_time	Vald jump height and Hawkins velocity/braking phase metrics relate to **movement quality and neuromuscular control.** Kenixon speed and distance metrics help assess **movement efficiency and fatigue.**

[1] Added as mRSI is a derivative of propulsive force

[2] In SBU dataset Jump Height is measured via Hawkins device (not Vald device)

Step 2

Table 1 helped determine the high-level frameworks that determine sports performance; Force, Movement/Gait, etc. The simple logic was to map metrics based on high-level force and movement measures without getting into the weeds of more granular metrics. Given the nature of the dataset, any analysis at the granular level was very unlikely to lead to any meaningful analysis.

Step 3

- Determined Device strength
- Mapped it to selection criteria (*Table 2*)

Table 2

Device	Strength	Selection criteria
Hawkins	Strong in force, power, impulse, and detailed biomechanical phases. Crucial for metrics tied to explosive strength, impulse, and braking forces.	Maps to Force based performance system (RFD)
Kenixon	Best suited for workload and external load profiling via accelerometer-derived metrics and event counts including speed and distance measures.	Maps to movement based performance system (ME&GC)
Vald	Fewer non-null metrics related to force/impulse but important for movement quality	Ignored for further analysis because Vald had much fewer data volume (51,300 records) and had inconsistent data coverage.

Step 4

Based on Steps 1-3, the following 5 metrics were selected.

Peak Propulsive Power(W), Jump Height (m), Peak Velocity (m/s), Speed_max (m/s) & Distance_total (m)

mRSI, was also initially considered, but was later removed.

Step 5

After metrics selection the following reasoning was used for further analysis

- Determine references based ranges and thresholds for metrics
- Determine directionality of metrics using ranges of low, normal, peak performance (driven by binary value logic)
- Ensured Metrics were based on individual athletes with first reading within the lookback period captured as baseline
- This logic flowed into the Flag System as well (Part 4 documentation)