
A Reproducible Workflow for Quantifying Serve-Reception and Side-Out Efficiency in Volleyball

Ortiqov Bekruh

Termiz State Pedagogical Institute, Teacher at the Department of Physical Education and PMT

Article information:

Manuscript received: 02 Oct 2025; **Accepted:** 02 Nov 2025; **Published:** 30 Dec 2025

Abstract: Serve-reception quality is a decisive “hinge” action in volleyball because it constrains the setter’s options and, consequently, side-out success. While coaches increasingly rely on video and notational systems, many teams still face two recurring problems: inconsistent coding between analysts and metrics that do not translate into training prescriptions. This article presents a reproducible, match-video workflow that converts serve-reception events into actionable KPIs for side-out efficiency. The framework integrates a minimal but information-dense coding schema for serve characteristics, reception technique and zone, and reception quality; explicit reliability procedures to reduce observer drift; and an analytics layer that links reception grades to side-out outcomes using interpretable models.

Keys words: volleyball analytics; serve-reception; side-out; notational analysis; reliability; performance indicators; video scouting.

INTRODUCTION

Serve-reception is the first decision-forcing event of Complex I and often determines whether the offense operates with full tempo or is forced into predictable, high-ball solutions. Match-analysis research consistently treats reception as a central performance indicator, but applied practice varies widely: some teams track only errors and “perfect passes,” while others build large coding windows with uncertain reliability and limited coaching value. Predictive work on serve and reception suggests that spatial and technical constraints, such as reception zone, receiver movement, and passing mode, can meaningfully shape reception efficacy and subsequent options. Likewise, studies of serve efficacy highlight how reception characteristics interact with serving choices and contextual factors, implying that serve pressure is only “good pressure” if it systematically degrades reception quality rather than merely increasing variability.

A second, under-discussed barrier is measurement quality. Analysts may agree at the “headline” level, yet disagree on intermediate categories, which are exactly the categories coaches need for training design. Recent reliability work demonstrates that detailed volleyball coding systems can achieve high inter- and intra-reliability when definitions, training, and drift checks are formalized, but it also stresses that reliability must be reported transparently rather than assumed. Finally, even when data are sound, coaching translation is often weak: staff receive dense tables instead of decisions.

Therefore, this article proposes a practical workflow that starts with match video, produces reliable serve-reception KPIs, and directly links them to side-out efficiency. The core contribution is not a new “magic statistic,” but a reproducible bridge from observable actions to training-relevant expectations,

including scenario testing that helps coaches prioritize interventions[8].

METHODS

This is a methodological paper describing a reproducible video-to-KPI pipeline. The workflow has four stages: coding schema, reliability protocol, feature engineering, and modeling.

Coding schema (minimal, coach-meaningful)

Each serve-reception event is coded from match video using a compact set of variables that are typically visible in broadcast angles:

Serve attributes: type, target zone, and outcome[3].

Reception descriptors: receiver role, reception zone, technique, and a 4-level reception grade aligned to setter options: 0 error, 1 out-of-system, 2 limited options, 3 full options[7].

Side-out outcome: point won/lost in Complex I; optionally, first-attack outcome if teams want a second layer of detail.

Reliability and observer drift control

Analysts receive a written operational manual with video examples for each category. Training includes joint coding of a small match segment, reconciliation, then blind double-coding of a second segment. Reliability targets follow established notational practice: Cohen's κ for nominal variables and weighted κ or ICC for ordinal grades, with scheduled re-coding checks to detect drift across the season [6].

Reception grades are transformed into team and player KPIs: distribution of grades, "perfect-pass rate," error rate, and grade-weighted reception score. To link reception to outcomes, an interpretable logistic regression is used where side-out success is predicted by reception grade, reception zone, serve type, and receiver role; random intercepts can be added for opponent or match when available, [3]. Scenario testing is implemented by shifting the reception-grade distribution and estimating expected side-out points per set.

RESULTS

Output KPIs and coach-ready diagnostics

The workflow yields three deliverables:

Reception Quality Profile: proportions of grades 0-3 by passer and by rotation.

Pressure Map: reception degradation by serve type and target zone.

Side-Out Expectation Table: expected side-out probability conditional on reception grade, plus "what-if" scenarios.

Literature-calibrated synthetic demonstration

To demonstrate decision utility without claiming new empirical match findings, we generated a synthetic dataset of serve-reception events calibrated to published patterns: (i) positive reception is associated with higher attack quality and overall offensive success [7]; (ii) reception zone and reception type are relevant predictors in serve/receive performance models. In the demonstration, side-out probability increases monotonically with reception grade: grade-3 receptions yield the highest expected side-out rates, grade-0 the lowest. When the team's grade-3 share is increased by 10 percentage points by shifting events from grade-1 to grade-2/3, the expected side-out points per set increase measurably, even if error rate is unchanged. This highlights a key coaching insight: reducing errors matters, but upgrading marginal receptions can be equally valuable because it expands tempo and attack options.

Reliability targets for applied settings

Using published reliability benchmarks, the framework sets explicit thresholds for acceptable agreement and drift resistance over time. Recent evidence shows that detailed coding systems can reach acceptable

inter- and intra-reliability across complexes and skill efficacy when training and re-checks are systematic [6]. Therefore, the workflow reports κ or ICC values per variable and flags categories that fall below target as “not decision-safe” until definitions or training are improved.

Practical translation example

The final dashboard identifies (a) passers with high grade-1 frequency under specific serve types, (b) rotations where reception grade collapses, and (c) opponent serve strategies that reliably shift the team out-of-system directly feeding training plans and scouting notes[8].

DISCUSSION

This article addresses a blunt truth coaches already feel: volleyball is drowning in numbers but starving for decisions. The proposed workflow emphasizes variables that are both observable and actionable, then forces the uncomfortable question “are we measuring this reliably enough to train from it?” before the first KPI is celebrated. Reliability matters because reception grading is inherently interpretive; without operational definitions and drift checks, teams may end up “optimizing” analyst bias rather than performance. Recent research demonstrates that high reliability is achievable in complex volleyball coding systems when training and prolonged intra-reliability assessment are built in, supporting the feasibility of applied, season-long analysis rather than one-off studies [6].

From a tactical perspective, the framework aligns with prior evidence that serve and reception variables interact with outcomes. Predictive studies show reception-related factors can be meaningful predictors in serve efficacy and reception performance, implying that serve pressure should be evaluated by how it reshapes reception quality distributions, not only by aces and errors[3]. Likewise, match-analysis work indicates that skill indicators can discriminate performance levels, reinforcing that reception should be embedded in a broader side-out model rather than treated as an isolated statistic[5].

The methodological contribution is scenario testing: converting changes in reception distribution into expected side-out points helps coaches prioritize interventions. For example, if training can shift “limited-option” receptions toward “full-option” receptions, the model predicts meaningful gains even without reducing raw error rate an insight consistent with the documented link between reception quality and attack performance. Additionally, the workflow can integrate team context variables from annotated match actions, bridging performance analysis with broader monitoring systems used in elite environments [8].

Limitations are clear. Broadcast video angles may obscure some variables (serve speed, precise trajectories), and synthetic demonstrations do not replace real match validation. Future work should apply this workflow to openly shareable match datasets, report full reliability tables, and compare model-based prescriptions with coaching judgments and training outcomes. In short: measure less, define better, and translate faster because volleyball points do not care how pretty your spreadsheet is.

REFERENCES

1. Silva M., Marcelino R., Lacerda D., João P. V. Match Analysis in Volleyball: a systematic review // Montenegrin Journal of Sports Science and Medicine. 2016. Vol. 5, No. 1. P. 35-46.
2. Paulo A., Zaal F. T. J. M., Fonseca S., Araújo D. Predicting Volleyball Serve-Reception // *Frontiers in Psychology*. 2016. Vol. 7. Art. 1694. DOI: 10.3389/fpsyg.2016.01694.
3. Valhondo Á., Fernández-Echeverría C., González-Silva J., Claver F. Variables that Predict Serve Efficacy in Elite Men’s Volleyball with Different Quality of Opposition Sets // *Journal of Human Kinetics*. 2018. Vol. 61. P. 167-177. DOI: 10.1515/hukin-2017-0119.
4. Stutzig N., Zimmermann B., Büsch D., Siebert T. Analysis of game variables to predict scoring and performance levels in elite men’s volleyball // *International Journal of Performance Analysis in Sport*. 2015. Vol. 15, No. 3. P. 816-829. DOI: 10.1080/24748668.2015.11868833.

5. Palao J. M., Manzanares P., Ortega E. Techniques used and efficacy of volleyball skills in relation to gender // *International Journal of Performance Analysis in Sport*. 2009. Vol. 9, No. 2. P. 281-293. DOI: 10.1080/24748668.2009.11868484.
6. Nicklin S., Nelson L., Carnegie E., Ranaweera J., Doncaster G. Assessing the inter- & intra-reliability of a customised volleyball performance analysis system to analyse complexes and the efficacy of the associated skills // *PLOS ONE*. 2025. Vol. 20, No. 11. e0337579. DOI: 10.1371/journal.pone.0337579.
7. Adamec P., Přidal V. The relationship between serve-receive quality and attack performance across different age categories in women's elite volleyball // *Journal of Physical Education and Sport*. 2024. Vol. 24, Issue 5. P. 1133-1138. DOI: 10.7752/jpes.2024.05130.
8. de Leeuw A.-W., van Baar R., Knobbe A., van der Zwaard S. Modeling Match Performance in Elite Volleyball Players: Importance of Jump Load and Strength Training Characteristics // *Sensors*. 2022. Vol. 22, No. 20. 7996. DOI: 10.3390/s22207996.
9. Nuriddinov, K. J. (2025). Psycho-pedagogical determinants in the formation of academic culture among students in pedagogical universities. *Educational Research in Universal Sciences*, 4(5), 96-100.