Technical and Data Report

VNL 2024

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Table of Contents

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1. INTRODUCTION

Over the last couple of decades, the FIVB has been observing closely a set of statistical and data items from selected top-level events, focusing on technical elements, perceived to influence the **attractiveness and popular appeal** of the sport.

The basic premise behind monitoring these variables has traditionally been that long rallies with many crossings of the net and ball contacts are preferred, but **simultaneously, a contrasting idea is pushing the other way**, i.e. long matches can be boring, short matches can be exciting. A match that is strongly contested, contains hard-fought long rallies, and is also short, fitting an acceptable 2-hour TV slot is difficult to imagine.

Moreover, a conservative view persists with rooted bias that volleyball is evolving towards an inferior version, especially in the women's game, compared to the slower-paced and less physical sport of the 1980's and 1990's. The conclusions derived from the observation of our developing sport have been used for proposed tests and changes to the rules of the game.

The goals of rule modification have so far been to increase volleyball's marketing value by making it more exciting and more balanced in terms of the rally winning probabilities for the serving and receiving teams. However, we have seen that throughout the realm of annual reporting our sport has **developed dramatically both in terms of popularity and purely commercially, even though some of the selected variables have been worsening from the perspective of the heritage of desired results**. Thus, probably the construction of a technical report from a marketing perspective makes sense only in an ad-hoc scenario when a specific commercial variable and/or strategy is being evaluated against the effects of technical changes. **Whereas the annual technical study of volleyball can and should be used as a tool for making executive decisions, the report itself should not contain solutions to non-existent or poorly understood economic problems**.

This realization has led to the idea of removing the marketing and commercial aspects from the annual report and shifting it towards a purely technical description of the development of volleyball. It would be wise to detach technical data from commercial indicators as these are areas of specific expertise that are not to be handled by a single group of experts.

In addition, as our sport becomes increasingly more complex from an IT standpoint, data that can be used for measuring trends also increases. This year's **men's and women's VNL**, our annual flagship event, will be used for the current detailed analysis. The **present report will be an attempt to implement new data as much as possible**, eventually fulfilling the

2. GOALS

The main goal of the FIVB Technical and Data report is **by providing a clear depiction of the characteristics of our sport at the highest level and their development over the observed period to enable and facilitate managerial and regulatory decisions.**

A secondary goal would be to **introduce new variables** from information collected from game technology providers that were **previously unavailable or difficult to obtain**, thus serving to **better understand the status of our sport**, backed by empirical data.

This report introduces the **performance to ranking analysis**, based on these variables that have become available since we started utilizing data collected by our service providers. An extension of the idea is the creation of **Team Technical Profiles**, helping to explore the links between the **most influential performance metrics and final ranking**.

The scope of the collected data is the highest ever, with all 2024 VNL matches analyzed.

3. INNOVATIONS

This year's report includes new variables, helping to depict a fuller picture of the game:

Average Total Ball in Play Time

AN INTERESTING PERSPECTIVE ON THE GAME, SHOWING THE ACTUAL TIME THE BALL IS IN MOTION PER MATCH. THIS DATA IS EXTRACTED FROM THE TIME STAMPS OF SCOUT FILES, SYNCHRONIZED WITH THE VIDEO RECORDING OF THE MATCH, SO ACCURACY IS VERY HIGH.

0,1,2,>2 Attacks per Rally Breakdown

PRECISE VIEW ON THE DISTRIBUTION OF RALLIES BASED ON THE NUMBER OF ATTACKS IN THEM, COMMONLY PERCEIVED AS THE BASIC CRITERIA FOR THE SPORT'S ATTRACTIVENESS.

Average Set Interval Overrun

TIME WASTED OVER THE 3- OR 5-MINUTE SET INTERVALS, BEFORE PLAY RESUMES.

Average Number of Rallies per Match

AN EASIER PARAMETER FOR QUICK COMPARISONS WHILE DISCUSSING TIME AND DURATION.

Player Physical Data

DATA, WHICH IS EASY TO OVERLOOK, BUT FUNDAMENTAL WHEN COMPARING TEAMS AND GENDERS

Substitutions and Timeouts

COLLECTING THE NUMBER OF USED SUBSTITUTIONS AND TIMEOUTS FOR TIME ALLOTMENT CALCULATIONS AND FOR UTILIZATION MEASUREMENTS

Average Challenge Time per Match

THE TOTAL TIME SPENT REVIEWING CHALLENGE REQUESTS PER MATCH.

Match Tension per Season

USING THE FIVB RROG COMMISSION'S MATCH TENSION FORMULA, AVERAGING THE COMPETITIVE BALANCE OF TEAMS PER SEASON ACROSS THE TWO GENDERS

Fastest Serve and Highest Spike

HELPFUL IN MONITORING PHYSICAL DEVELOPMENT AS WELL AS ADDING ENTERTAINMENT VALUE.

Matches by Number of Sets

ATTAINING A BETTER UNDERSTANDING ON THE CAUSES OF VARIATION IN DURATION AND THE CORRELATION WITH MATCH TENSION

Additionally, the following new data sets and analysis points are introduced in the 2024 FIVB Technical and Data Report:

Crunch And Super Crunch

Metrics on

Attack Efficiency*

Serve Performance (errors and aces)

Block Performance (touches and kills)

While in Crunch Time

After point 20 (10 in set 5), difference in score <=2 pts.

And Super Crunch Time

One or both teams are over 25 (15 in set 5).

Attack Efficiency

Efficiency* of attack, based on the quality of reception.

Single criteria for comparison of overall technical performance – reception/set/attack.

In System

Positive and Perfect Reception – expected high success rate

Out-of-System

Negative and Borderline Reception (2nd touch on or about the attack line) – high ball scenario.

Profiles

Team Technical Profiles

Key Performance Indicators, innovatively presented with respect to overall impact.

15 data points that link final ranking with performance, comparing team stats to competition averages

Medal – Winning KPI Profiles

The four most impactful KPIs when comparing the Top 3 teams to the others.

* Attack efficiency is calculated by subtracting errors and blocked spikes from kills and dividing them by the number of total attempts: **E = (“#”-“=”-“/”) / Attempts**

4. KEY INSIGHTS – 2024 VNL

A. COMPETITIVE BALANCE

The **competitive balance between the teams in VNL went in different ways** – in the men’s edition we saw harder-fought matches and a decrease in average duration, which translates into an increase of

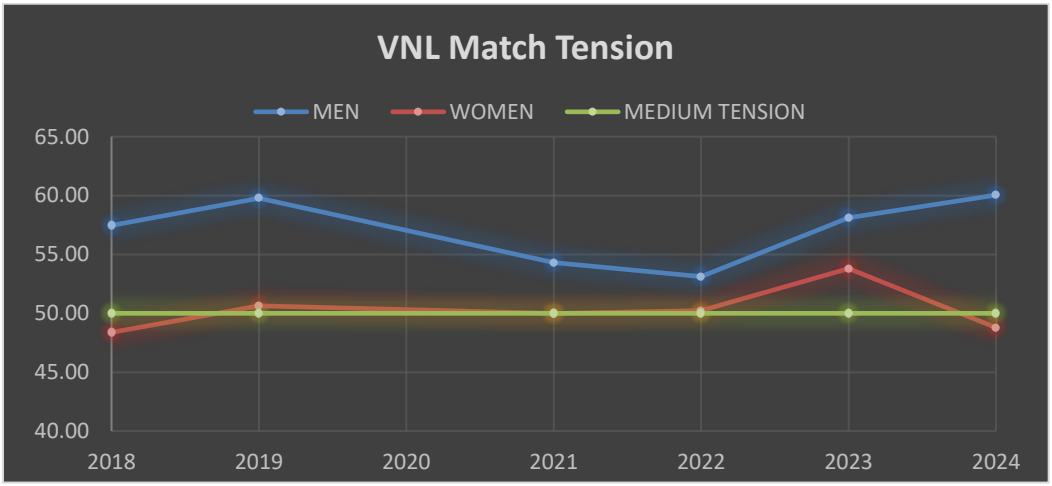
ball-in-play time, while in the women's competition we saw a larger decrease in total duration, but this was partially due to a decrease in match tension.

- Match tension[i] was at **60.04** for the men and **48.80** for the women – meaning overall tension was overall medium and low respectively.

Only **13%** of women's matches went into tie-break, against **28%** of the men's.

B. TIME AND SPEED OF THE GAME

- The average total duration of men's matches was **1:48:53**, whereas the women's edition saw shorter bouts at an average of **1:37:44**.
- The average ball-in-play percentage showed a **slight improvement**[1], reaching **14.51%** in the men's VNL, and **17.91%** in the women's. Translated in time, this meant:
- The average flying ball time per match was **15:48 (mm:ss)** for the men and **17:30 (mm:ss)** for the women, even with a shorter match duration.
- In both genders, the automated in-out VCS brought the challenge review time to only about **2 minutes per match, which in the men's edition is lower than the average set interval overrun (at 130 s. vs. 88 s. for the women.)**



- No discernible change in the overall speed of the game was observed, with the men's game showing on average **5.2 ball contacts per rally** and the **women's – 6.4.**
- The **in-play minute average ball contacts (contact intensity)** were slightly higher in the women's VNL at **58.89 vs. 57.14 for the men. It's interesting to note that ball contacts per minute are increasing for the women and decreasing for the men – combined with longer rallies and larger proportion of the ball-in-play time led to a competition with more data touchpoints, seeming with a stronger action essence, even though math tension is lower.** The slower speed of the ball, more touches in block (and defense by extension) may explain the phenomenon. Moreover, the attacks are higher for the men – producing a longer

[1] Compared to the last season with available data – 2022.

trajectory (**highest 3.58m vs 3.12m for the women**) and touches (blocks that enable attack in transition) are much higher in the women (**3.6 vs. 2.6 per set**), which could explain the parity.

- **Substitutions and Timeouts per set and match** are important in determining what the not-in-play portion of the match is comprised of and to plan interruptions for the streaming production. For the time calculation, we have an average of 5 sec per substitution and 35 sec per timeout.

MEN

Substitutions per Set / Match	Timeouts per Set/Match
5.62 / 22.0	2.91 / 11.4

WOMEN

Substitutions per Set / Match	Timeouts per Set/Match
5.65 / 20.48	2.98 / 10.79

On average, we have **8:29** minutes per match spent in timeouts and substitutions per match in the men's VNL **(54% of the ball-in-play time)** and **8:00** for the women **(46% of the ball-in-play time).**

	MEN	WOMEN
Average Time in Subs and Timeouts Per Match	08:29 mm:ss	08:00 mm:ss
Average Ball-In-Play Time	15:48 mm:ss	17:30 mm:ss

C. RALLY DATA

- **Pseudo-rallies** kept their usual metrics at **25% for the men and 17% for the women**. The gap between genders continues to close, albeit at a very slow pace.

Both genders have the same ace expectancy at 6% of attempts, however in the men's game the average number of errors is almost 19%, while in the women's, it's less than 10%. This may come unexpected as we consider lower speeds of service, but the difficulties in reception come not only from the kinetic force in the flying ball.

- The average rally duration in the men's competition was **5.46 s, and 7.15 s if pseudo rallies are not considered.**
- The average rally duration in the women's competition was **6.50 s, and 7.64 s if pseudo rallies are not considered.**

MEN

Average Rally Duration	Proper Rally Duration
5.46	7.15

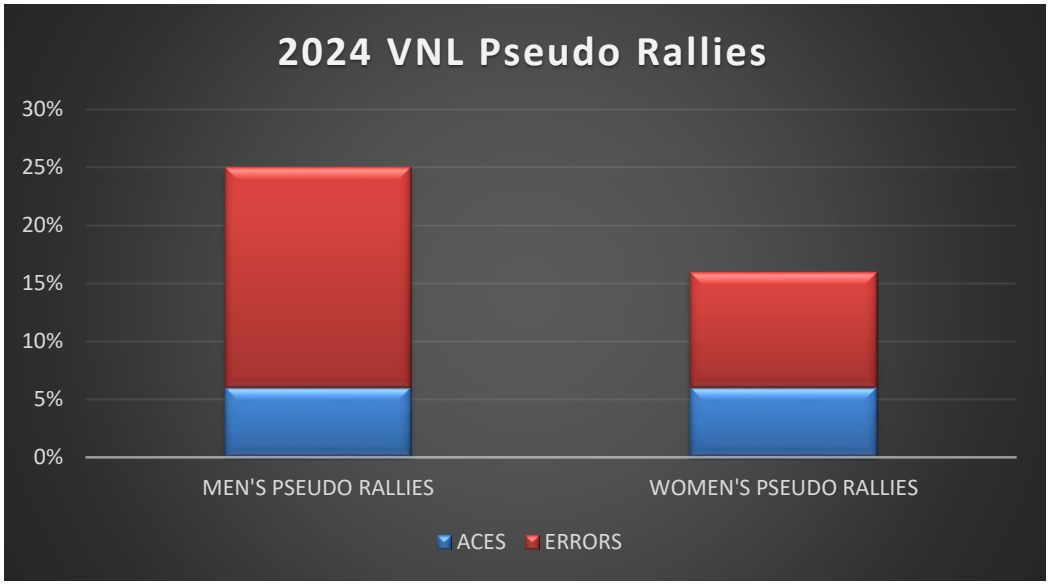
- Slight decrease in the average data from the last measured points in 2022. **(-1.5%),** slight increase **(+0.55%)** in the proper data from the last measured points in 2022.

WOMEN

Average Rally Duration	Proper Rally Duration
6.50	7.64

- Measurable decrease in the average data from the last measured points in 2022. **(+4.00%),** substantial increase **(+7.50%)** in the proper data from the last measured points in 2022.

Overall, in the women's game we are seeing a positive trend into longer play, reinforcing the increased data points discussed in the previous section, while in the men's game, the parameters are almost without change.



- **Average net crossings** per rally were **1.92** for the men's edition and **2.37** for the women. This indicates an increase from the last measured matches in 2022 for the women **(+4.5%)** and a standstill in the men.
- **Rallies by number of attacks –** a different view on the expected composition of the rally in terms of skills and attack-defense balance. About half of all rallies in both genders are over after

a single attack, contributing to 25% vs 17% in men's and women's pseudo rallies respectively, leaving only **less than a quarter of them with more than one attack for the men and 35% for the women.**

MEN WOMEN

D. PHYSICAL AND SKILL DATA

- **Average height is** an easy parameter to monitor long-term trends in successful players' physical characteristics. The correlation between average height and final ranking is not statistically sound. **Average age** is significant in determining the importance of the event considering a specific time in the Olympic cycle as it shows whether VNL is regarded as a preparatory competition, also used to introduce new players, or as the highlight of the season. Age is calculated over the full list of 30 players per team, thus not entirely precise as per players on court as each week many teams prepare different rosters. In 2024, the average age was about an year lower than 2023, meaning most of the teams kept their 2023 rosters with the exception of a couple of squads that chose to focus solely on the Olympic Games and play with a younger "B" team (most notably USA men.)

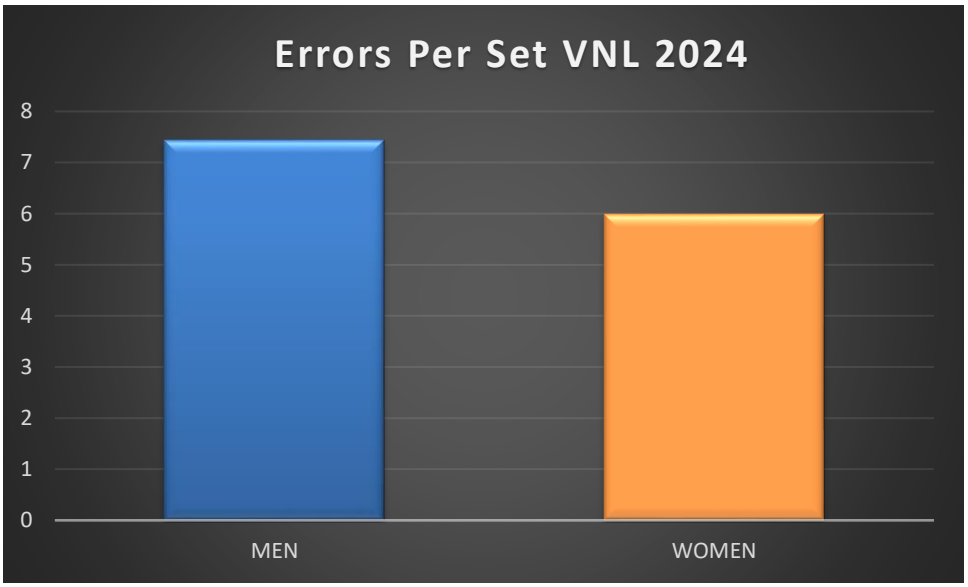
MEN WOMEN

Average Height	Average Age	Average Height	Average Age
197	27.14	184	26.16

- Quality of reception is a **direct derivative of the strength of opponent serve and technical abilities of the receivers, with a much higher, but constant weight on the service**. This means at the highest level **all teams have similar serving strategies, simplifying the receiving game,**

which is easily observed in the identical reception formations in all rotations. The only exception to this is the attack from zone 1 for the opposite in rotation P1 in some of the women's teams. Thus, distinguishing between quality of reception will bring up the smaller weight factor to be a decisive one – isolating the technical preparedness of the players. We have observed that this is much more noticeable in the women's game, **with the top 3 teams having almost 4% better positivity in reception than the 16-team average, in contrast to just 0.5% for the men's medalists**. Positivity is entirely clear as it is a composite parameter, comprised of perfect and positive receptions, and the ratio between them will be a subject of further analysis, but nevertheless, it gives a very good idea of how the sport differs in both genders. On average, men's positive receptions were at **45.5%, with top 3 teams at 46%**, while women had an average of **48.12% with the top 3 at 52%.**

The quality of reception is understandably lower in the men's VNL because of the strength and speed of service; however, errors are also higher.



- Total errors on average are lower in the **women's VNL at 6 per set vs. 7.44 per set for the men**. This is partially due to the higher risks taken in service and attack in the men's game.
- As an innovation, we have begun collecting the **fastest serves and highest spikes** per match and have current bests for these two in both genders.

MEN

Fastest Serve	Highest Spike
144.7	3.58

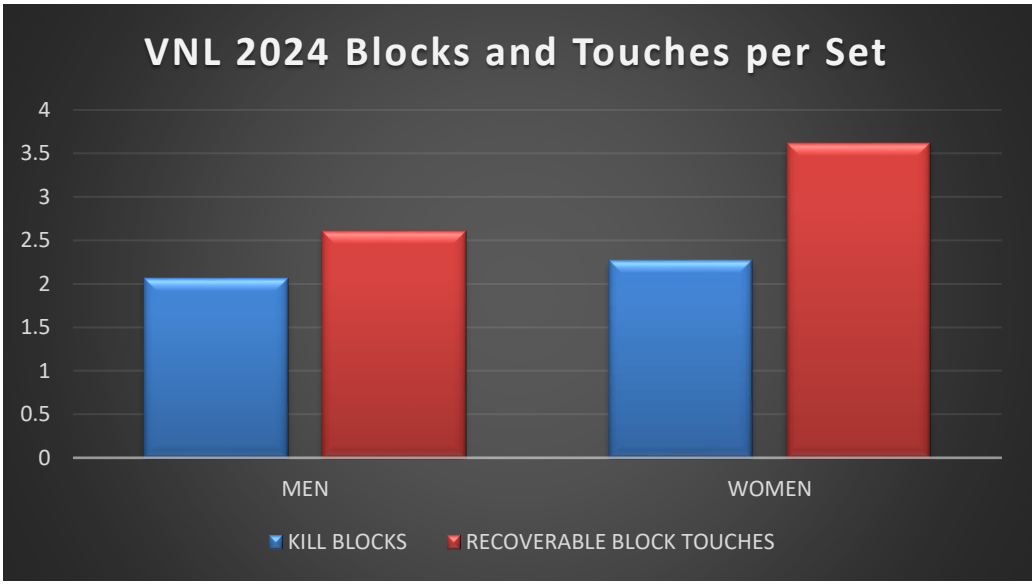
WOMEN

Fastest Serve	Highest Spike
118.4	3.12

- **Blocks and touches** per set are an important parameter that goes beyond the direct kills, encompassing the defensive work of blockers, which facilitates attacks in transition (influencing sport results, as traditionally about a third of all points are won on own service[2].)

Both kills and touches are higher in the women's game, and these are partially **cross-dependent on attack efficiency.** Lower attack efficiency is a **part of why we have more touches**, but on the other hand we observe lower efficiency **partially** because of more block kills and more touches.

There is no observable trend when comparing blocks and touches between the top 3 and all teams average in both genders, thus we reach the next innovation in the Technical and Data report, that has proven to be much more impactful on ranking, and that's why we conclude it's **only partially cross-dependent on blocks and touches: Attack Efficiency.**



E. ATTACK EFFICIENCY OVERVIEW

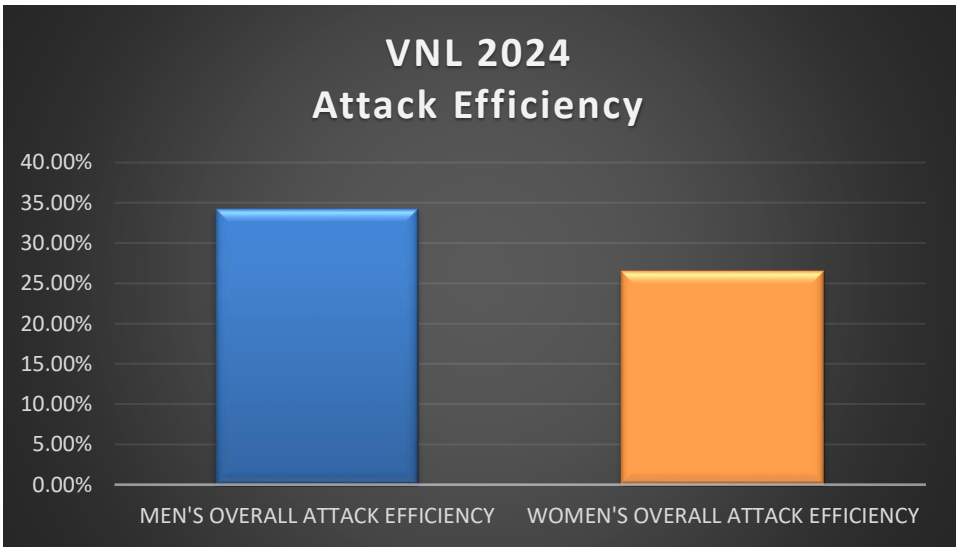
The following explores how attack efficiency metrics influence a team's overall performance and final ranking in the competition. **In-system efficiency pertains to attacks after positive reception ("#" and "+"), and out-of-system to attacks after negative reception ("-" and "!").**

- Both **in-system** and **out-of-system attack efficiencies** contribute to a team's overall performance. However, **out-of-system efficiency** has a stronger impact on final rankings.
- **OVERALL attack Efficiency** serves as a critical indicator, integrating both types of efficiencies to reflect team success comprehensively.

The analysis emphasizes the importance of attack efficiency, particularly in handling out-of-system scenarios, as a determinant of competitive advantage in volleyball.

[2] As seen in previous FIVB RROG research, see Picture of the Game 2022.

- **IN SYSTEM Attack Efficiency**: Moderate negative correlation with team ranking (-0.45), indicating that teams with higher in-system attack efficiency tend to rank higher (lower numerical rank). The overall high technical level of VNL teams explains this fact – in the modern elite game, positive receptions are usually instant kills, meaning the difference between lower and higher ranked teams is not so significant in such circumstances.
- **OUT OF SYSTEM Attack Efficiency**: Stronger negative correlation (-0.60), **suggesting that out-of-system attack efficiency plays a critical role in achieving better rankings.** This is indicative of one of the main deciding factors for overall success – **better performance in high-ball situations.** This includes the level of setting (decision, speed, calls and precision), but also variability and technical, physical and mental capacity of the attackers.
- **OVERALL Attack Efficiency**: Significant negative correlation (-0.60), **confirming that overall attack efficiency is a major determinant of team success**, which is hardly surprising, but confirmed empirically in the current research.



Key Comparison Points

1. **Adaptability vs. Precision**: Men's teams perform better and rely more on adaptability in expectation of strong serves (out-of-system efficiency), while women's teams benefit are more likely to be ranked higher with guaranteed precision and execution of planned situations (in-system efficiency).
2. **Balanced Play**: For both genders, high overall attack efficiency is crucial, emphasizing the importance of consistent performance across all phases of play.

Crunch Time Attack Efficiency

- Efficiency in the decisive moments of the set is crucial and a subject of research in sport psychology. We explored the correlation between ranking and performance in the critical parts of the game. For more in-depth analysis, we split the high-stake situations into two categories: **Crunch Time** and **Super Crunch Time** (see criteria in the previous section).
- The top teams in men edition showed noticeably **higher attack efficiency in Crunch and especially Super Crunch rallies**.
- Simultaneously, these teams (France, Japan, Poland) performed equally or better in serve (aces, errors). It's important to note that teams that lacked superior attack efficiency, could **balance their performance with lower number of errors per set and more touches in block** (recovered and transitioned balls) – i.e. the team of Japan.
- In the **women's VNL**, the top-placed teams had **less dependency on Crunch and Super Crunch performance**, mainly because such situations were in general very infrequent, as the match tension is substantially lower than in the men VNL.

5. MEN'S 2024 VNL

5.1 General Match Data

All data presented below is based on the total match duration, including the intervals between sets.

M VNL	Avg. Total Duration	Avg. # of Rallies	Rallies/min, total	Match Tension	5 set matches	4 set matches	3 set matches
2018	02:13:54	167	1.50	57.46	21%	28%	51%
2019	02:18:51	173	1.46	59.76	22%	40%	38%
2021	01:59:51	166	1.38	54.30	22%	29%	49%
2022	02:06:11	164	1.51	53.13	14%	40%	46%
2023	01:52:30	172	1.53	58.12	23%	35%	42%
2024	01:48:53	175	1.59	60.04	28%	36%	37%

In 2024, men's VNL matches improved marginally in terms of match tension and average duration. A slight positive trend is also observed in the perceived speed of the game, whereas the small bump in the average number of rallies per match can be explained with the shift of sets per match distribution as well as the small increase in tension.

5.2 Team Technical Profiles

The following are the team-specific profiles, with color-coded parameters, compared with competition averages: Green – above average, Yellow – average, Red - below average.

FRANCE as winners **had higher than average attack efficiency in all sections, but with outstanding 59% result in the super crunch scenarios (11 killed and 1 blocked, no errors, out of 17 total attempts.)**

JAPAN as runners-up had **lower than average overall attack efficiency, but they compensated with the highest number of block touches per set – 3.18 and least proportion of serve errors - 15% and second lowest of all errors per set – 6.37.**

POLAND as bronze medalists **had the highest in-system efficiency – 55% of all teams in the competition and shared best in overall efficiency with Italy – 42%, also best in kill blocks per set 2.57, but their reception positivity and crunch time efficiency were below average.**

FRANCE M	MEN								
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	37	POSITIVE RECEPTION %	49		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	38			OVERALL	6%	20%	PER SET	2.16	1.98
	SUPER CRUNCH	59	IN SYSTEM EFF	48	CRUNCH TIME	7%	20%		ERRORS	
	TEAM RANK	1	OUT OF SYSTEM	24	SUPER CRUNCH	20%	27%	PER SET	7.32	

JAPAN M	MEN								
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	32	POSITIVE RECEPTION %	45		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	44			OVERALL	6%	15%	PER SET	1.49	3.18
	SUPER CRUNCH	50	IN SYSTEM EFF	43	CRUNCH TIME	9%	12%		ERRORS	
	TEAM RANK	2	OUT OF SYSTEM	20	SUPER CRUNCH	11%	16%	PER SET	6.37	

POLAND M	MEN								
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	42	POSITIVE RECEPTION %	44		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	32			OVERALL	6%	19%	PER SET	2.57	2.11
	SUPER CRUNCH	50	IN SYSTEM EFF	55	CRUNCH TIME	4%	21%		ERRORS	
	TEAM RANK	3	OUT OF SYSTEM	30	SUPER CRUNCH	0%	0%	PER SET	7.19	

SLOVENIA M	MEN								
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	35	POSITIVE RECEPTION %	48		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	28			OVERALL	8%	17%	PER SET	1.80	2.85
	SUPER CRUNCH	13	IN SYSTEM EFF	47	CRUNCH TIME	8%	15%		ERRORS	
	TEAM RANK	4	OUT OF SYSTEM	31	SUPER CRUNCH	9%	21%	PER SET	7.25	

ITALY M	MEN								
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	42	POSITIVE RECEPTION %	45		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	48			OVERALL	6%	20%	PER SET	2.17	2.60
	SUPER CRUNCH	25	IN SYSTEM EFF	54	CRUNCH TIME	4%	21%		ERRORS	
	TEAM RANK	5	OUT OF SYSTEM	27	SUPER CRUNCH	0%	33%	PER SET	7.10	

CANADA M — MEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	38	POSITIVE RECEPTION %	45	OVERALL	6%	20%	PER SET	2.20	2.60
	CRUNCH TIME	41	IN SYSTEM EFF	49	CRUNCH TIME	4%	20%	ERRORS		
	SUPER CRUNCH	74	OUT OF SYSTEM	18	SUPER CRUNCH	5%	20%	PER SET	8.02	
	TEAM RANK	6								

BRAZIL M — MEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	37	POSITIVE RECEPTION %	40	OVERALL	5%	17%	PER SET	2.07	2.91
	CRUNCH TIME	36	IN SYSTEM EFF	48	CRUNCH TIME	5%	18%	ERRORS		
	SUPER CRUNCH	32	OUT OF SYSTEM	23	SUPER CRUNCH	12%	12%	PER SET	7.31	
	TEAM RANK	7								

ARGENTINA M — MEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	34	POSITIVE RECEPTION %	48	OVERALL	5%	17%	PER SET	2.56	2.44
	CRUNCH TIME	35	IN SYSTEM EFF	51	CRUNCH TIME	5%	17%	ERRORS		
	SUPER CRUNCH	37	OUT OF SYSTEM	12	SUPER CRUNCH	5%	21%	PER SET	5.59	
	TEAM RANK	8								

CUBA M — MEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	38	POSITIVE RECEPTION %	48	OVERALL	5%	20%	PER SET	2.30	2.44
	CRUNCH TIME	27	IN SYSTEM EFF	51	CRUNCH TIME	5%	18%	ERRORS		
	SUPER CRUNCH	16	OUT OF SYSTEM	22	SUPER CRUNCH	5%	20%	PER SET	7.73	
	TEAM RANK	9								

SERBIA M — MEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	35	POSITIVE RECEPTION %	45	OVERALL	7%	20%	PER SET	1.84	2.49
	CRUNCH TIME	28	IN SYSTEM EFF	47	CRUNCH TIME	7%	15%	ERRORS		
	SUPER CRUNCH	50	OUT OF SYSTEM	31	SUPER CRUNCH	0%	29%	PER SET	7.54	
	TEAM RANK	10								

GERMANY M — MEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	30	POSITIVE RECEPTION %	47	OVERALL	6%	19%	PER SET	1.44	3.15
	CRUNCH TIME	35	IN SYSTEM EFF	46	CRUNCH TIME	4%	20%	ERRORS		
	SUPER CRUNCH	48	OUT OF SYSTEM	13	SUPER CRUNCH	4%	25%	PER SET	7.18	
	TEAM RANK	11								

USA M — MEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	32	POSITIVE RECEPTION %	48	OVERALL	5%	18%	PER SET	2.00	3.24
	CRUNCH TIME	31	IN SYSTEM EFF	46	CRUNCH TIME	3%	20%	ERRORS		
	SUPER CRUNCH	54	OUT OF SYSTEM	22	SUPER CRUNCH	0%	25%	PER SET	8.11	
	TEAM RANK	12								

NETHERLANDS M	MEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	30	POSITIVE RECEPTION %	42	OVERALL	8%	21%	PER SET	2.02	1.98
	CRUNCH TIME	36			CRUNCH TIME	7%	27%	ERRORS		
	SUPER CRUNCH	26	IN SYSTEM EFF	32	SUPER CRUNCH	3%	34%	PER SET	8.13	
	TEAM RANK	13	OUT OF SYSTEM	16						

BULGARIA M	MEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	26	POSITIVE RECEPTION %	42	OVERALL	6%	24%	PER SET	1.95	2.56
	CRUNCH TIME	17			CRUNCH TIME	10%	16%	ERRORS		
	SUPER CRUNCH	17	IN SYSTEM EFF	42	SUPER CRUNCH	14%	0%	PER SET	9.01	
	TEAM RANK	14	OUT OF SYSTEM	8						

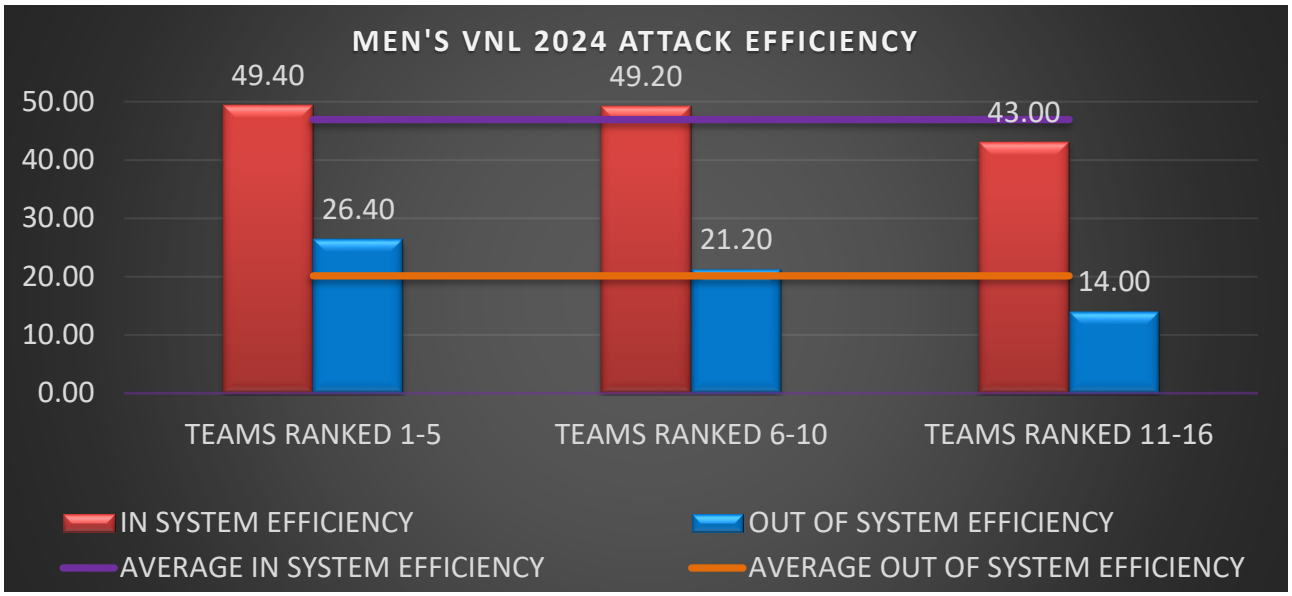
IRAN M	MEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	31	POSITIVE RECEPTION %	48	OVERALL	5%	17%	PER SET	2.04	2.60
	CRUNCH TIME	22			CRUNCH TIME	2%	17%	ERRORS		
	SUPER CRUNCH	21	IN SYSTEM EFF	46	SUPER CRUNCH	0%	36%	PER SET	7.31	
	TEAM RANK	15	OUT OF SYSTEM	14						

TURKIYE M	MEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	29	POSITIVE RECEPTION %	44	OVERALL	6%	17%	PER SET	2.30	2.70
	CRUNCH TIME	25			CRUNCH TIME	5%	23%	ERRORS		
	SUPER CRUNCH	53	IN SYSTEM EFF	46	SUPER CRUNCH	4%	23%	PER SET	7.84	
	TEAM RANK	16	OUT OF SYSTEM	11						

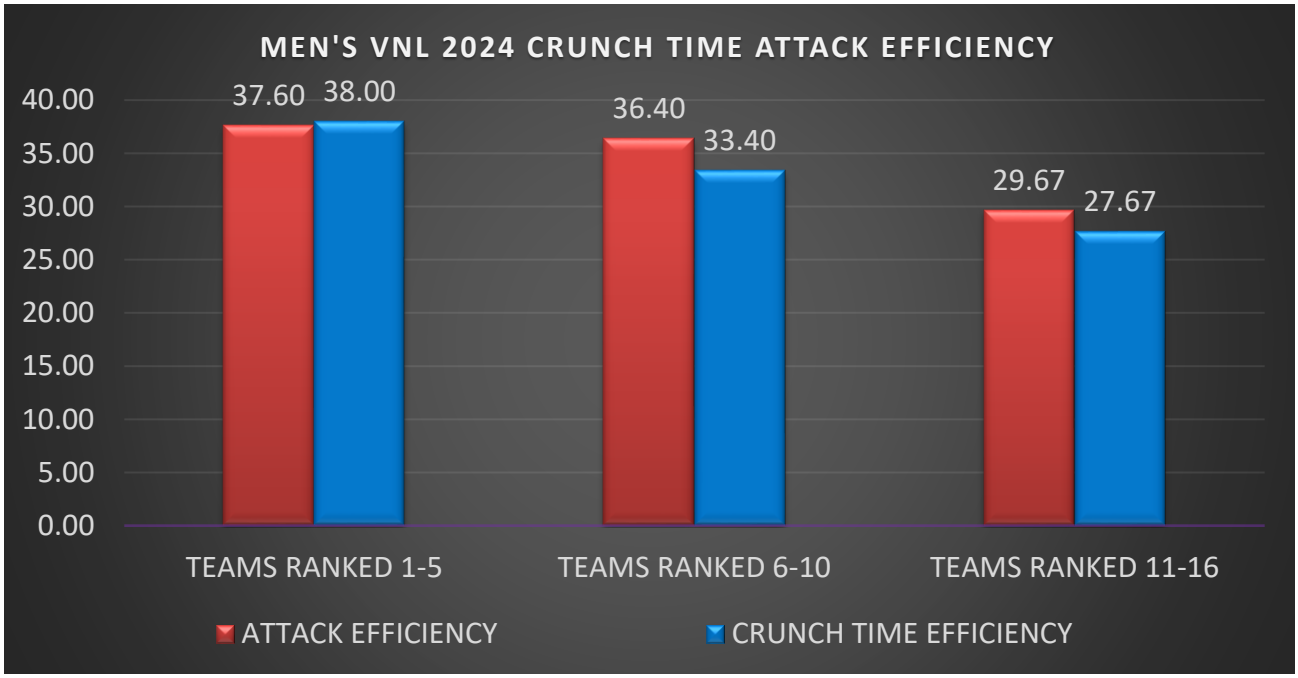
5.3 Attack Efficiency

- **IN SYSTEM Attack Efficiency**: The correlation between team rankings and in-system attack efficiency is moderate. This indicates that while strong in-system efficiency is valuable, men's teams can compensate for slightly lower in-system performance by excelling in other areas.
- **OUT OF SYSTEM Attack Efficiency**: This metric shows a stronger influence on team success, suggesting that top men's teams are highly adept at managing plays outside their standard setups, reflecting adaptability and strategic execution.
- **OVERALL Attack Efficiency**: Men's rankings strongly correlate with overall attack efficiency, as it encompasses in-system and out-of-system metrics. This reinforces the idea that balanced performance across all scenarios is essential for success in men's volleyball.

Determining the impact of attack per reception quality on final ranking

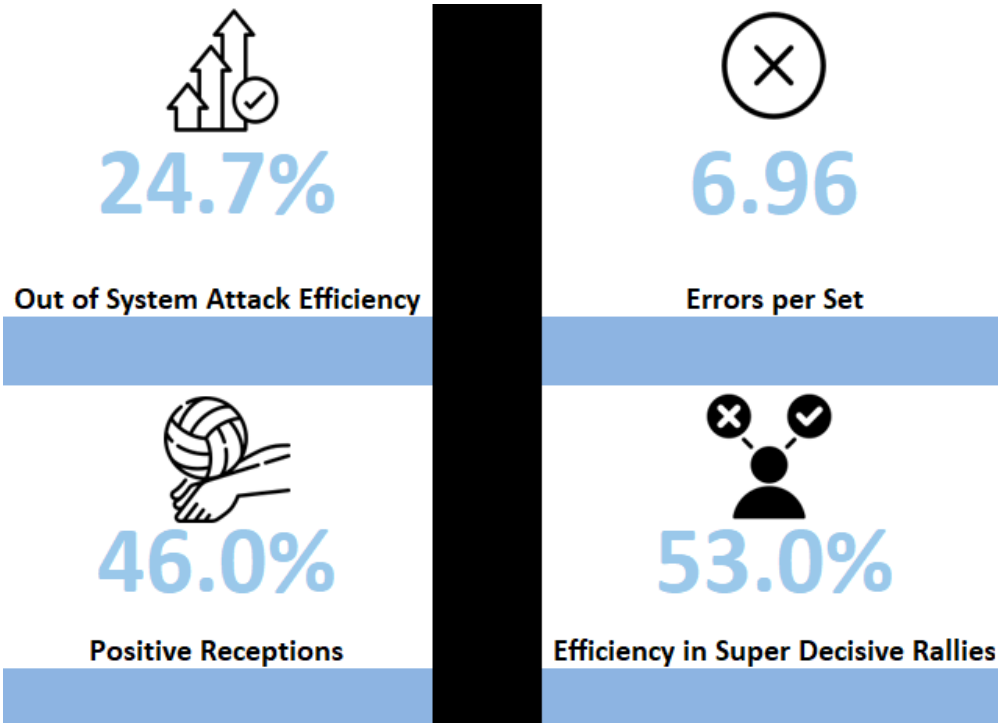


Crunch Time Attack Efficiency - Comparing overall performance to performance in crucial parts of the match



5.4 Medal-Winning KPI Profile

What makes a team medal-worthy, facing the best teams in the world? The following shows the most impactful KPIs that we have observed as differentiating the top 3 teams from the rest.



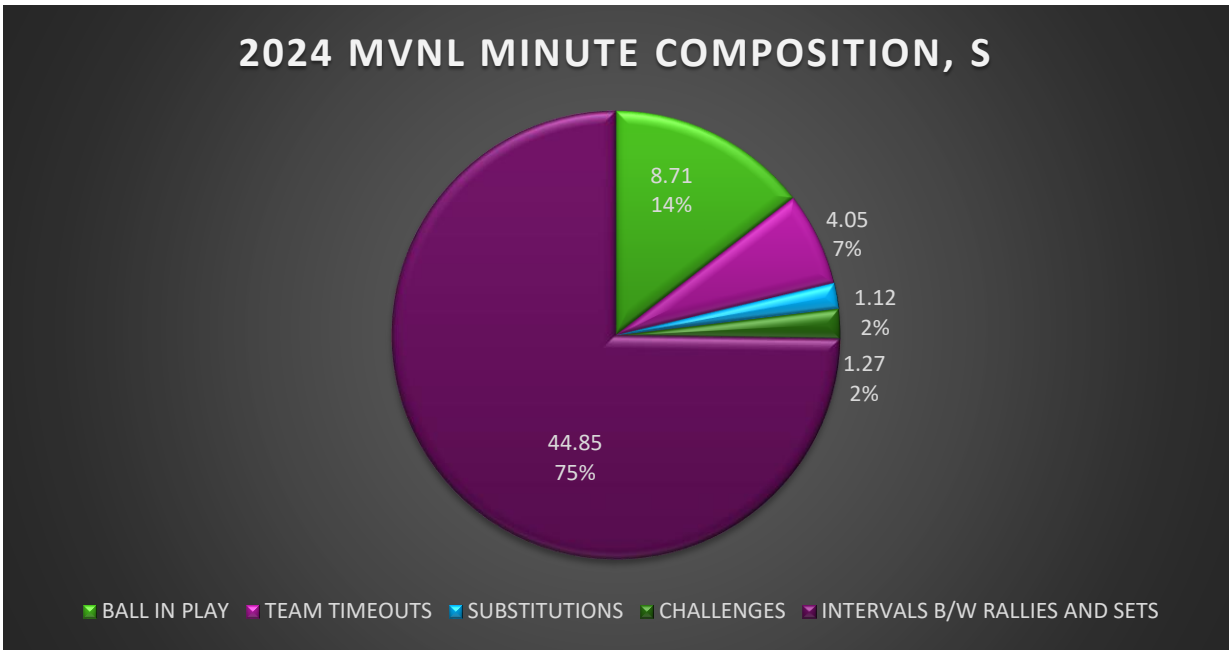
5.5 Challenge Data

2024	# Challenge Per Match	# Challenges Per Set	Sec Per Ch.	Sec per Set	Sec per Match
MVNL	3.19	0.83	39	32	125

A view that settles the disputes on whether the challenge process wastes too much time in high-level volleyball. Only about two minutes per match, this is one of the least influential time factors and this is due to the technological advancement of the system, including automated IN/OUT calls.

5.6 VNL Minute

A visualization of the match duration time components in the men's tournament, compiled in 60 seconds, thus showing the VNL minute.



6. WOMEN'S 2024 VNL

6.1 General Match Data

In 2024, women's VNL matches **decreased significantly in terms of match tension and average duration**. 2024 is a record low in terms of number of 5-set matches, with only 13% in the season.

W VNL	Avg. Total Duration	Avg. # of Rallies	Rallies/min, total	Match Tension	5 set matches	4 set matches	3 set matches
2018	2:08:34	160	1.47	48.38	20%	30%	50%
2019	2:10:52	163	1.48	50.65	18%	37%	45%
2021	2:17:04	162	1.50	50.00	20%	29%	50%
2022	1:43:33	164	1.59	50.24	18%	38%	43%
2023	1:52:58	164	1.55	53.80	30%	27%	43%
2024	1:37:44	159	1.65	48.80	13%	36%	51%

Source: Calculated from official VIS data

6.2 Team Technical Profiles

The following are the team-specific profiles, with color-coded parameters, compared with competition averages: Green – above average, Yellow – average, Red - below average.

ITALY as winners **had above average overall attack efficiency, were best in kill blocks at 3.08 per set, excelled in in-system efficiency (joined by Poland) at 43% and came only second to Poland in out-of-system efficiency at 24%.**

BRAZIL as runners-up had **the best reception stats of all teams at 55% positivity - 15% and second lowest of all errors per set – 5.26. They were however below average in crunch time scenarios and only 17% in their super crunch situations (4 killed, 1 blocked and 1 error out of 12 attempts).**

POLAND as bronze medalists **had the highest super-crunch efficiency – 62% of all teams in the competition (14 killed and 1 error from 21 attempts), very high efficiency in crunch time (68 killed, 4 blocked and 10 errors from 141 attempts) and both of these parameters were better than their overall efficiency. They suffered from lower-than-average reception positivity and almost 3 times lower out-of-system efficiency than the top 2 teams.**

ITALY W	WOMEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	33	POSITIVE RECEPTION %	54		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	20			OVERALL	7%	10%	PER SET	3.08	4.03
	SUPER CRUNCH	0	IN SYSTEM EFF	43	CRUNCH TIME	10%	8%		ERRORS	
	TEAM RANK	1	OUT OF SYSTEM	24	SUPER CRUNCH	0%	20%	PER SET	5.73	

BRAZIL W	WOMEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	30	POSITIVE RECEPTION %	55		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	21			OVERALL	6%	9%	PER SET	3.03	3.33
	SUPER CRUNCH	17	IN SYSTEM EFF	37	CRUNCH TIME	4%	8%		ERRORS	
	TEAM RANK	2	OUT OF SYSTEM	27	SUPER CRUNCH	11%	11%	PER SET	5.26	

POLAND W	WOMEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	29	POSITIVE RECEPTION %	47		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	38			OVERALL	5%	10%	PER SET	2.83	3.46
	SUPER CRUNCH	62	IN SYSTEM EFF	43	CRUNCH TIME	4%	9%		ERRORS	
	TEAM RANK	3	OUT OF SYSTEM	10	SUPER CRUNCH	5%	11%	PER SET	5.69	

JAPAN W	WOMEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	29	POSITIVE RECEPTION %	57		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	31			OVERALL	5%	9%	PER SET	1.55	4.55
	SUPER CRUNCH	29	IN SYSTEM EFF	38	CRUNCH TIME	4%	7%		ERRORS	
	TEAM RANK	4	OUT OF SYSTEM	25	SUPER CRUNCH	0%	0%	PER SET	4.77	

CHINA W	WOMEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE			BLOCKS AND TEAM ERRORS		
	OVERALL	34	POSITIVE RECEPTION %	51		ACES	ERRORS		KILLS	TOUCHES
	CRUNCH TIME	37			OVERALL	6%	7%	PER SET	2.37	3.63
	SUPER CRUNCH	0	IN SYSTEM EFF	50	CRUNCH TIME	1%	10%		ERRORS	
	TEAM RANK	5	OUT OF SYSTEM	18	SUPER CRUNCH	0%	0%	PER SET	5.46	

TURKIYE W — WOMEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	27	POSITIVE RECEPTION %	51	OVERALL	7%	11%	PER SET	2.85	3.53
	CRUNCH TIME	17			CRUNCH TIME	9%	9%	ERRORS		
	SUPER CRUNCH	50	IN SYSTEM EFF	36	SUPER CRUNCH	0%	9%	PER SET	6.69	
	TEAM RANK	6	OUT OF SYSTEM	7						

USA W — WOMEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	28	POSITIVE RECEPTION %	50	OVERALL	5%	11%	PER SET	2.43	4.40
	CRUNCH TIME	27			CRUNCH TIME	3%	12%	ERRORS		
	SUPER CRUNCH	50	IN SYSTEM EFF	42	SUPER CRUNCH	0%	0%	PER SET	5.66	
	TEAM RANK	7	OUT OF SYSTEM	17						

NETHERLANDS W — WOMEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	28	POSITIVE RECEPTION %	45	OVERALL	5%	11%	PER SET	2.64	4.19
	CRUNCH TIME	42			CRUNCH TIME	4%	3%	ERRORS		
	SUPER CRUNCH	50	IN SYSTEM EFF	42	SUPER CRUNCH	0%	0%	PER SET	5.62	
	TEAM RANK	8	OUT OF SYSTEM	17						

CANADA W — WOMEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	27	POSITIVE RECEPTION %	43	OVERALL	6%	12%	PER SET	2.37	4.84
	CRUNCH TIME	30			CRUNCH TIME	9%	7%	ERRORS		
	SUPER CRUNCH	38	IN SYSTEM EFF	39	SUPER CRUNCH	14%	29%	PER SET	6.70	
	TEAM RANK	9	OUT OF SYSTEM	19						

DOMINICAN W — WOMEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	26	POSITIVE RECEPTION %	42	OVERALL	5%	11%	PER SET	1.91	3.41
	CRUNCH TIME	26			CRUNCH TIME	3%	11%	ERRORS		
	SUPER CRUNCH	25	IN SYSTEM EFF	31	SUPER CRUNCH	0%	0%	PER SET	6.48	
	TEAM RANK	10	OUT OF SYSTEM	16						

SERBIA W — WOMEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	24	POSITIVE RECEPTION %	47	OVERALL	5%	14%	PER SET	2.60	3.22
	CRUNCH TIME	28			CRUNCH TIME	2%	11%	ERRORS		
	SUPER CRUNCH	26	IN SYSTEM EFF	27	SUPER CRUNCH	8%	8%	PER SET	7.18	
	TEAM RANK	11	OUT OF SYSTEM	20						

GERMANY W — WOMEN

STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	27	POSITIVE RECEPTION %	50	OVERALL	7%	11%	PER SET	2.07	3.38
	CRUNCH TIME	22			CRUNCH TIME	7%	11%	ERRORS		
	SUPER CRUNCH	0	IN SYSTEM EFF	35	SUPER CRUNCH	0%	0%	PER SET	6.29	
	TEAM RANK	12	OUT OF SYSTEM	19						

FRANCE W	WOMEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	22	POSITIVE RECEPTION %	43	OVERALL	6%	13%	PER SET	2.07	2.41
	CRUNCH TIME	31			CRUNCH TIME	9%	7%		ERRORS	
	SUPER CRUNCH	14	IN SYSTEM EFF	31	SUPER CRUNCH	11%	11%	PER SET	6.78	
	TEAM RANK	13	OUT OF SYSTEM	3						

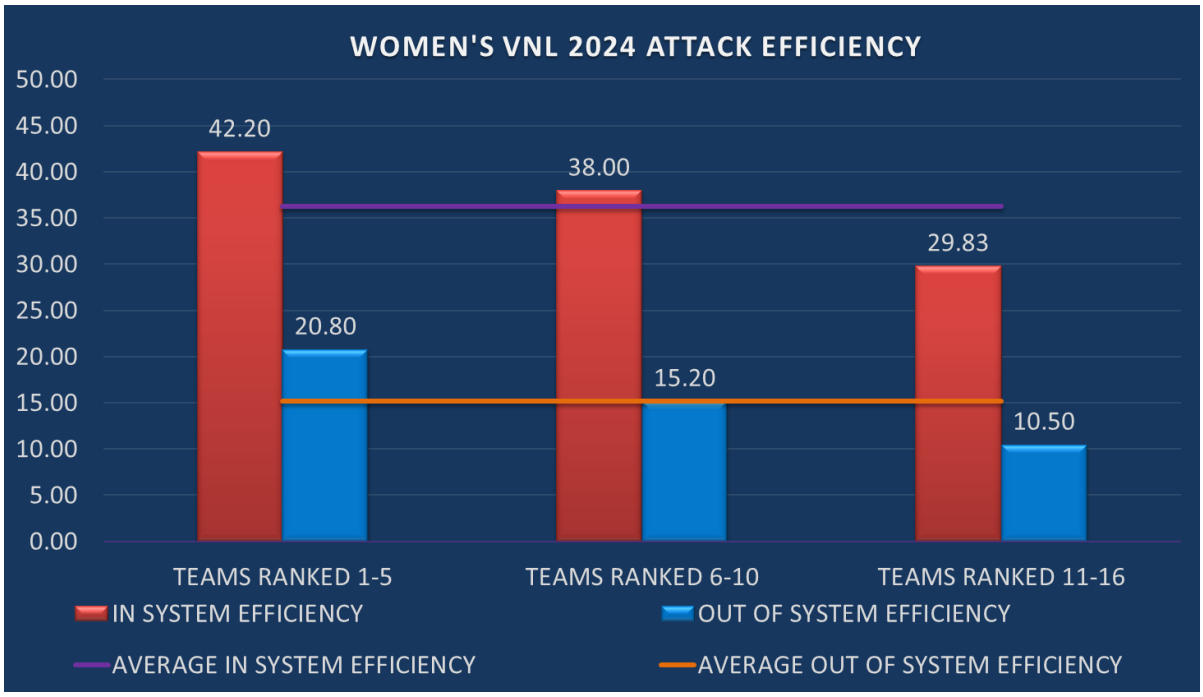
THAILAND W	WOMEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	23	POSITIVE RECEPTION %	50	OVERALL	5%	9%	PER SET	0.96	3.32
	CRUNCH TIME	21			CRUNCH TIME	5%	8%		ERRORS	
	SUPER CRUNCH	0	IN SYSTEM EFF	34	SUPER CRUNCH	0%	0%	PER SET	5.40	
	TEAM RANK	14	OUT OF SYSTEM	7						

KOREA W	WOMEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	17	POSITIVE RECEPTION %	41	OVERALL	5%	10%	PER SET	1.85	2.90
	CRUNCH TIME	25			CRUNCH TIME	4%	8%		ERRORS	
	SUPER CRUNCH	0	IN SYSTEM EFF	21	SUPER CRUNCH	0%	0%	PER SET	5.56	
	TEAM RANK	15	OUT OF SYSTEM	9						

BULGARIA W	WOMEN									
STATS AND RANKINGS	ATTACK EFFFICIENCY		EFFICIENCY IN AND OUT OF SYSTEM		SERVE PERFORMANCE	ACES	ERRORS	BLOCKS AND TEAM ERRORS	KILLS	TOUCHES
	OVERALL	19	POSITIVE RECEPTION %	44	OVERALL	7%	10%	PER SET	1.76	3.29
	CRUNCH TIME	22			CRUNCH TIME	6%	6%		ERRORS	
	SUPER CRUNCH	0	IN SYSTEM EFF	31	SUPER CRUNCH	0%	33%	PER SET	6.71	
	TEAM RANK	16	OUT OF SYSTEM	5						

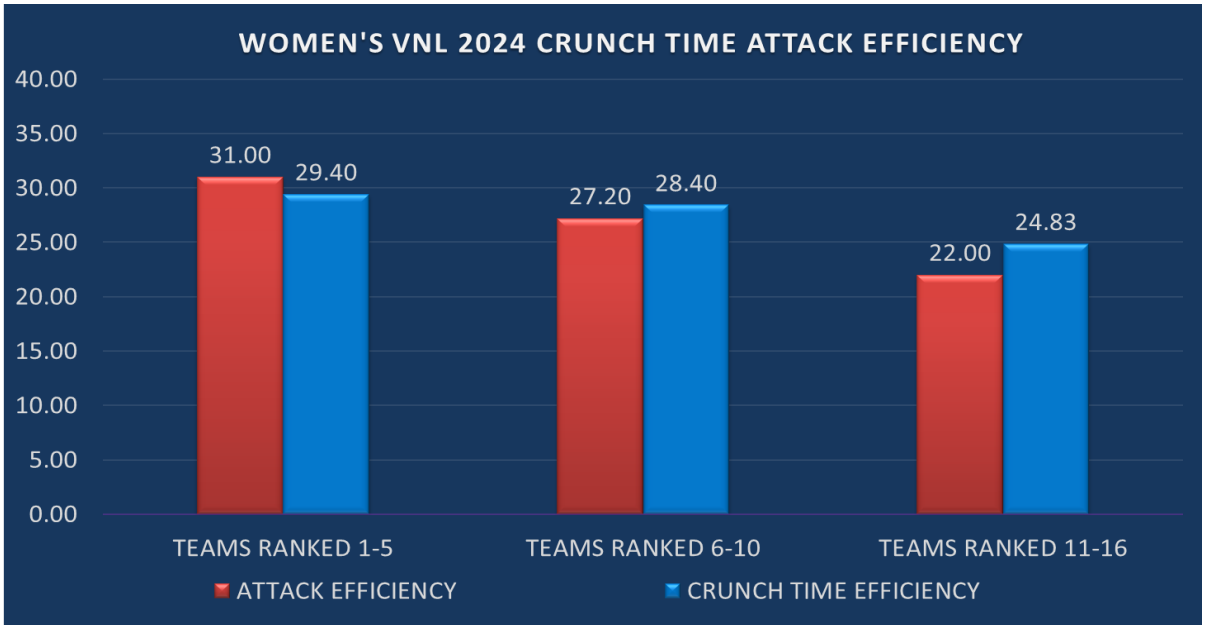
6.3 Attack Efficiency

- **IN SYSTEM Attack Efficiency**: For women's teams, in-system attack efficiency **plays a more critical role than in men's teams.** It contributes significantly to success, reflecting the importance of taking advantage of advantageous opportunities created in an environment with lower expected overall efficiency among all teams and lower competitive balance.
- **OUT OF SYSTEM Attack Efficiency**: While also very important, out-of-system efficiency might have slightly less weight in determining women's rankings compared to men's rankings. This could reflect differences in game dynamics, where overall reception is better and serves are less powerful.
- **OVERALL Attack Efficiency**: Like in men's volleyball, overall attack efficiency is highly predictive of success. Women's teams with well-rounded skills and the ability to adapt to different situations tend to perform better.



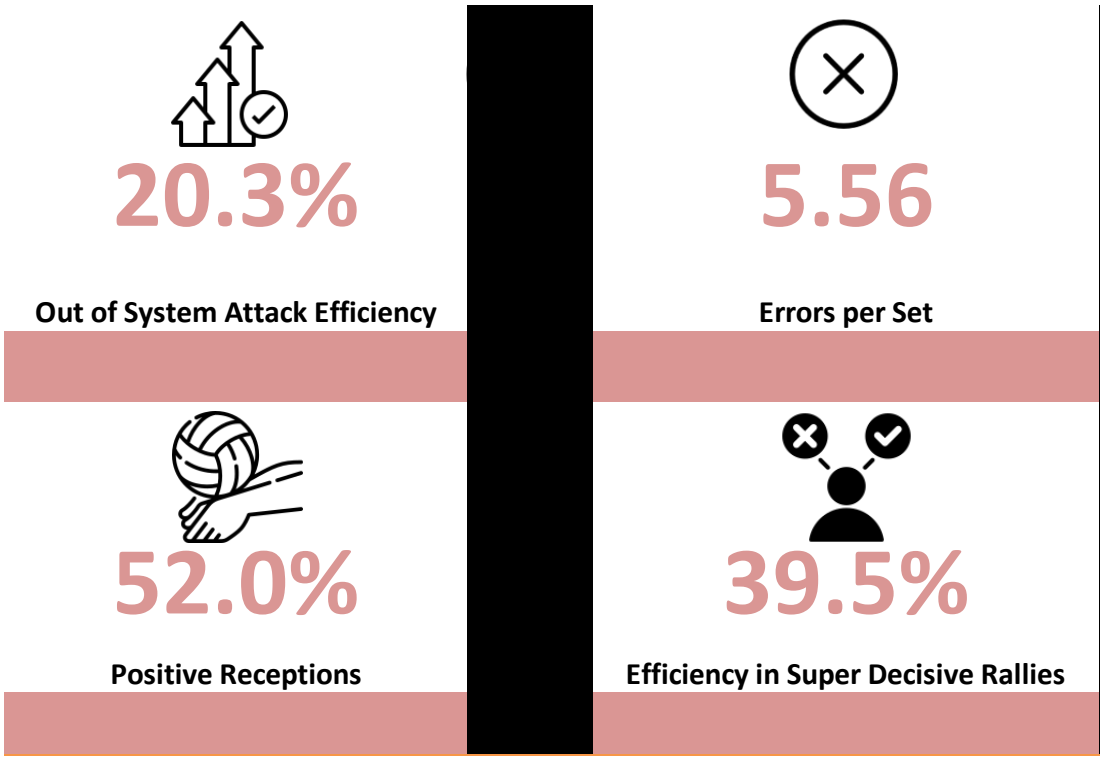
Crunch Time Efficiency

Less impactful than in the men's game, mainly because of the low number of crunch time situations, stemming from lower tension matches, but still making an impact, especially as seen in the analysis of the top 3 teams.



6.4 Medal-Winning KPI Profile

The following shows the most impactful KPIs that we have observed as differentiating the top 3 teams from the rest.



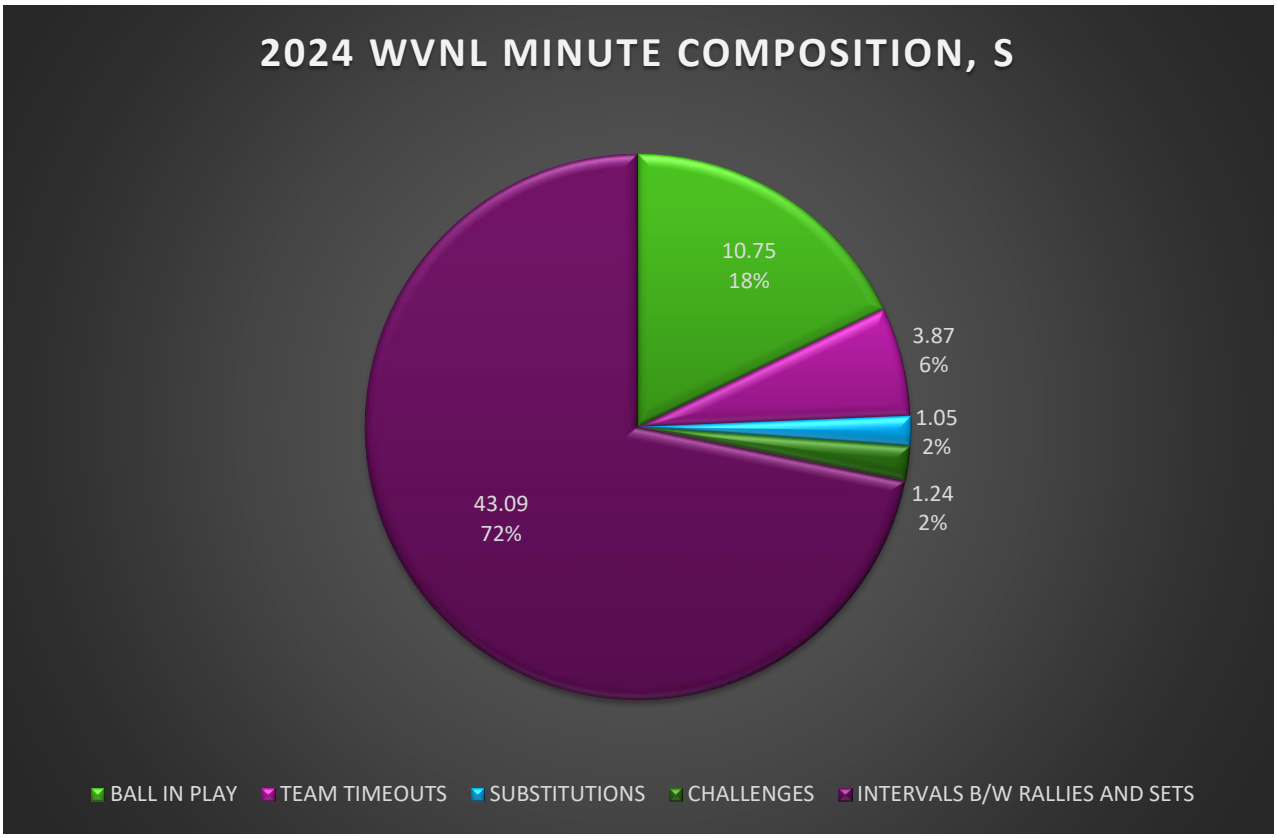
6.5 Challenge Data

2024	# Challenge Per Match	# Challenges Per Set	Sec Per Ch.	Sec per Set	Sec per Match
WVNL	3.19	0.83	38.2	32	125

The challenge time data is very similar to men's edition, with a small impact on overall match duration.

6.6 WVNL Minute

A visualization of the match duration time components in the women's tournament, compiled in 60 seconds, thus showing the VNL minute.



[i] Match tension is calculated based on closeness of score in each set. Scale is 0 to 100.

- Set with 2-points difference (e.g. 25-23, 26-24,15-13)- 20 points
- Set with 3-5 points difference (e.g. 25-22, 25-20,15-12, 15-10)- 15 points
- Set with 6-10 points difference (e.g. 25-19, 25-15, 15-9, 15-5) - 10 points
- Set with the difference more than 10 points (e.g. 25-14, 15-4) - 0 points
- If one team scores more than 25 (15 – for 5th set) points (e.g. 26-24, 16-14) - bonus is 5 points
- If both teams score more than 25 (15) points (e.g. 28-26, 17-15) - bonus is 10 points

Tension evaluation scale for a match (tournament) :
0-50 points - low tension
50 – 75 points - medium tension
76 – 100 points - high tension
> 100 points - super match