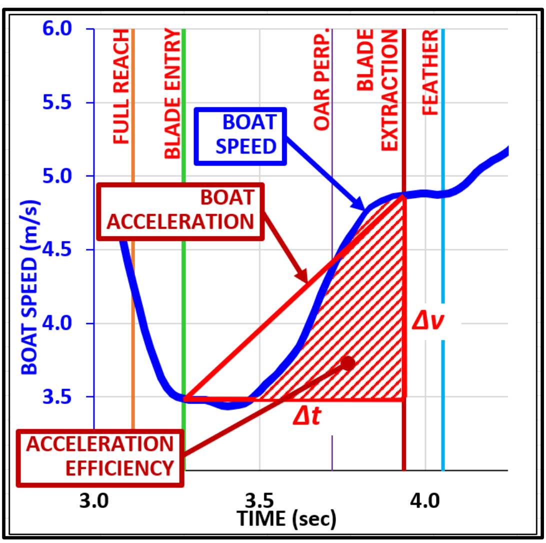
2.9.3 Drive Acceleration

Drive acceleration is the technique factor measuring the boat's acceleration (m/s^2) between the blade entry and the blade extraction. The acceleration is a simple calculation of the change in speed (Δv) divided by the change in time (Δt). The acceleration rate is measured as a straight line between the boat's speed at entry and extraction, which does not reflect the actual movement of the boat as it does not accelerate at a consistent rate. This technique factor provides a value that measures the crew's ability to apply power and stay connected with the blade in the water.

Figure 2.9.3a Drive Acceleration shows a boat speed curve and identifies the straight line of boat acceleration from entry to extraction.

Figure 2.9.3a *Drive Acceleration*



$$\textbf{DRIVE ACCELERATION} = \frac{(Vs_{ex} - Vs_{c1})}{(Vt_{ex} - Vt_{c1})}$$

where: Vs_{c1} = video frame interval speed catch1
Vs_{ex} = video frame interval speed blade extraction
Vt_{c1} = video frame time feather
Vt_{ex} = video frame time blade extraction

Figure 2.9.3a Drive Acceleration identifies the drive acceleration efficiency (DAE), which is the boat's movement during the power application stage, entry to extraction. The DAE is the boat's movement compared to the theoretical movement at constant acceleration, not including the initial speed. As the boat does not accelerate on a consistent basis, the DAE represents a percentage of the linear drive acceleration. The following formula compares the actual boat movement to the theoretical movement at constant acceleration.

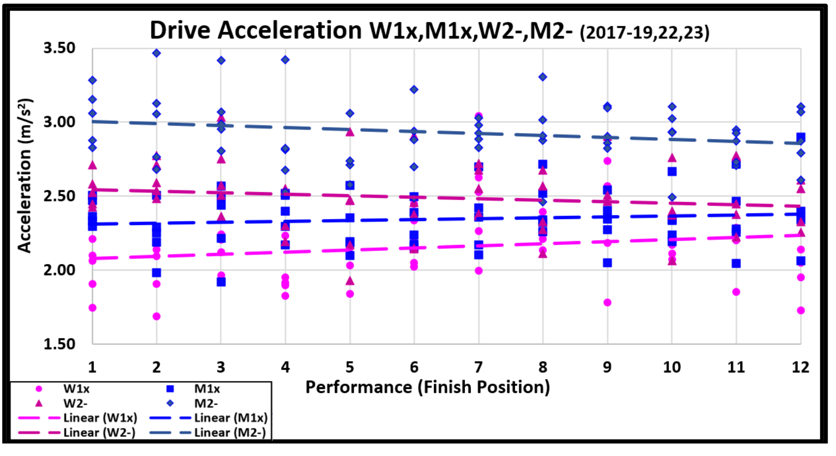
Calculation for Drive Acceleration Efficiency (DAE):

$$\mathbf{DAE} = \frac{[\,(Vd_{ex} - Vd_{c1}) - Vs_{c1} \cdot (Vt_{ex} - Vt_{c1})\,]}{[\,(Vs_{ex} - Vs_{c1}) \cdot (Vt_{ex} - Vt_{c1}) / 2\,]}$$

where: Vd_{c1} = video boat distance at catch 1
Vd_{ex} = video boat distance blade extraction
Vs_{c1} = video frame interval speed catch 1
Vs_{ex} = video frame interval speed extraction
Vt_{c1} = video frame time catch 1
Vt_{ex} = video frame time blade extraction

Drive acceleration data from singles and pairs taken at the World Championships between 2017 and 2023 is shown in Figure 2.9.3b Drive Acceleration Singles Pairs.

Figure 2.9.3b *Drive Acceleration Singles Pairs*



Crew performance of the power application stage should analyze drive acceleration, drive acceleration efficiency and boat speed change, entry to extraction. Boat speed increase between entry and extraction is a third technique factor used to evaluate the power application stage.

$$\textbf{BOAT SPEED INCREASE} = \boldsymbol{Vs_{ex}} - \boldsymbol{Vs_{c1}}$$

where: $\boldsymbol{Vs_{ex}}$ - video interval speed blade extraction
$\boldsymbol{Vs_{f}}$ – video interval speed catch 1

Drive acceleration is affected by the power capacity of the crew and the rigging leverage dimensions. High drive acceleration values may reflect lighter rigging loads (leverage), resulting in lower boat speed increases or reduced effective stroke lengths.

Figure 2.9.3c Drive Acceleration Data provides data from the World Championships for various boat classes.

Figure 2.9.3c *Drive Acceleration Data*

Boat Class	**Drive Accel.**	Standard Deviation	Min.	Max	**Drive Eff.**	Data Ref. (# of crews)
W1x	**2.15**	0.25	1.69	3.04	**85.9%**	(59) WC ’17,’18,’19,’22,’23
W2x	**2.37**	0.22	2.01	2.77	**84.9%**	(16) WC ’19, ’22, ‘23
W4x	**2.39**	0.26	1.75	2.81	**83.0%**	(18) WC ’17,‘23
W2-	**2.49**	0.23	1.93	3.03	**93.4%**	(59) WC ’17,’18,’19,’22,’23
W4-	**2.59**	0.22	2.22	2.93	**94.3%**	(18) WC ’19,’23
W8+	**2.60**	0.30	1.94	3.14	**91.5%**	(40) WC ’17,’18,’19,’22,’23
M1x	**2.35**	0.19	1.92	2.90	**81.0%**	(59) WC ’17,’18,’19,’22,’23
M2x	**2.67**	0.18	2.32	2.89	**76.8%**	(17) WC' 19,' 22, '23
M4x	**2.57**	0.28	2.10	3.06	**70.0%**	(14) WC '17,’23
M2-	**2.93**	0.24	2.46	3.64	**94.1%**	(60) WC ’17,’18,’19,’22,’23
M4-	**3.11**	0.26	2.54	3.42	**90.0%**	(18) WC ’17,’19,’23
M8+	**3.07**	0.29	2.32	3.66	**88.5%**	(51) WC ’17,’18,’19,’22,’23

The crew's only opportunity to accelerate the boat/crew system is between entry and extraction during the power application stage. During this stage, the power applied by the athlete to the oar handles is used to a) accelerate the boat, b) accelerate the athlete's center of mass (COM), and c) overcome resistance. The movement of the athlete's COM is greater than the boat's as the athlete travels a greater distance during the drive. While the boat moves from point A to B during the drive phase, the athlete moves with the boat, and their COM also moves within the boat the distance from the catch position to the finish position. The athlete's COM movement during the drive requires part of the athlete's applied force, resulting in reduced boat acceleration. However, the force used results in a new location of the athlete's COM (finish position) within the boat. The new COM location is potential momentum that can be used during the recovery to accelerate the boat.

During the recovery, the athlete pulls their footstops toward their COM, transferring their momentum (inertia) and increasing the boat's speed at racing rates. The movement of the athlete's COM during the rowing stroke cycle is critical to effective rowing technique. Coaches must understand how the athlete's COM movements, affect performance not only on the recovery but also on the drive.

The drive acceleration efficiency factor provides a comparative value that provides insight into the drive acceleration factor value. Higher acceleration rates with lower DAE will limit the distance the boat moves and the average drive speed during the power application stage.