A Technical Model for Pole Vault Success
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This is a modified version of an article published in *Track Coach*

Pole vaulting is perhaps the most technical event in track and field. It requires the speed and sprint mechanics of a sprinter, the explosive jumping ability of a long jumper, and the kinesthetic awareness and upper-body strength of a gymnast. The event demands many skills that are completely independent of one another and yet must be combined seamlessly to achieve success.

The objective of this paper is to create a technical model for the pole vault. This model would be of value to all coaches who work with or who have pole vaulters on their team. Often, coaches leave the pole vaulters to coach themselves because the coach does not have knowledge of the event. Not only is this not safe, but it is not fair to athletes competing in an event with such high technical demands. This model is easy to follow and provides a simple means for technical analysis.

**The Technical Model: an Overview**

The technical model breaks down pole vault technique into 7 parts from the start of the approach through bar clearance. A high emphasis is placed on the approach and plant as these are the keys to pole vault success. All subsequent phases of the vault are highly dependent on the correct execution of these steps. A pole vaulter is only as good as their approach. The 7 phases of the technical model are:

1. Acceleration Phase
2. Transition Phase
3. Plant Phase
4. Takeoff Phase
5. Swing to Inversion Phase
6. Push and Turn Phase
7. Bar Clearance Phase

Within each phase are several key points. These are the specific actions that coaches should look for when working with their vaulters. There are a total of 30 evaluation points in the technical model.

A checklist is provided to aid in the use of the technical model. The checklist details the technical model and lists all 30 points of analysis. The technique in each of the seven phases of the technical model is demonstrated by a stick-figure drawing.

**Explanation of the Technical Model**

The following section will break down each phase and point of the technical model. For the purposes of this analysis, “top hand” will refer to the vaulter’s dominant hand or the one that is placed over the head during the plant.
Acceleration Phase (first 4-6 steps)

The technical component of the pole vault approach is often overlooked. This is a big mistake. If things are done right on the runway, good things will happen in the air.

Many errors that occur later in the vault can be traced back to a problem early in the approach. Much can be done to make the pole vault approach faster and more efficient. In so doing, the athlete is able to generate higher velocities at takeoff, thereby allowing them to use stiffer and longer poles and make higher clearances. The main goal of the Acceleration Phase is the development of momentum through a consistent and repeatable stride pattern.

1. **Top hand held at hip; bottom hand at sternum:** The vaulter’s top hand should be held at the hip and the bottom hand should be held close to and in front of the sternum. A slight upward and downward bouncing of the arms will aid in stabilizing the athlete’s trunk and pelvis.

2. **Push the pole:** The pole should be carried at an angle such that the direction of all force generated at ground contact will be directed through the long axis of the pole (Fig. 1). By doing this, the pole will be pushed rather than carried. This minimizes the downward rotational forces of the pole and allows the vaulter to accelerate more efficiently.

3. **Correct acceleration mechanics:** Correct acceleration mechanics are essential to making a smooth acceleration during the early approach. Any deficiencies in acceleration mechanics will be magnified when the athlete is forced to run with a pole in their hands. Athletes should accelerate using a stride pattern that moves from longer to shorter strides. Coaches should look for the following key points:
   a. a slight forward lean with the head, shoulders and hips aligned
   b. dorsiflexed toes
   c. foot contact made slightly behind the athlete’s center of mass and,
   d. upward pelvic orientation

4. **Relaxed upper body:** It is important for vaulters to have a relaxed upper body while sprinting. This not only spares energy but it also allows the athlete to take advantage of the elastic energy properties of the trunk and pelvic musculature. This will create a more efficient and faster approach. A relaxed upper body means that the athlete is loose through the shoulders, neck, face, arms and torso. No excessive straining should be visible.

5. **Smooth acceleration:** A smooth acceleration is necessary for an athlete to have a consistent approach run and takeoff mark. This is key to success in the vault. Vaulters should strive to have a rhythmic pattern to their approach with an increasingly faster stride cadence as the athlete approaches takeoff. The early approach will be characterized by low frequency, high displacement strides. This can be evaluated visually or heard through the rhythm of the vaulter’s foot strike.
Transition Phase (middle 4-6 steps)

The Transition Phase occurs over the middle 4-6 steps of the approach. This phase is characterized by a more erect posture and a move from acceleration to sprinting mechanics. The goal of the Transition Phase is the attainment of maximum controllable velocity.

1. **Transition to sprint mechanics**: Just as acceleration mechanics are key to the early approach, correct sprint mechanics are crucial to achieving maximum velocity. During this phase the vaulter should make a transition from acceleration to sprint mechanics. The 6 key points of correct sprint mechanics are as follows:
   a. high knee recovery,
   b. upward pelvic orientation,
   c. dorsiflexed toe,
   d. stepping over the opposite knee,
   e. running on the balls of the feet, and
   f. foot contact made under the athlete’s center of mass

   Coaches should be aware of and correct any deviations in sprint mechanics that may occur as a result of lowering the pole or anticipating the plant.

2. **Gradual pole drop**: Vaulters should begin gradually lowering their pole 6-8 steps out from the plant. The pole should be lowered in a slow and controlled fashion. A sudden and rapid pole drop should be avoided, as this will cause the athlete’s trunk to be pulled forward. A correctly executed gradual pole drop will aid in the athlete’s acceleration since the dropping pole will “pull” the athlete forward.

3. **Bottom hand acts as fulcrum**: As the pole drops, the bottom hand should remain close to and in front of the sternum. The top hand should move down and back so that it is off the hip and below the waistline. This will allow the bottom hand to act as the fulcrum for the pole drop. It will also put the vaulter into a position where they can move the pole forward and upward during the plant. This is very advantageous because it allows the vaulter to initiate the rotation of the pole to an upright position before the pole makes contact with the box.

4. **Relaxed upright upper-body**: By this point in the approach, the athlete should assume a more upright posture. The vaulter should avoid forward lean caused by the downward rotation of the pole or backward lean to counterbalance the downward rotation of the pole. Both of these problems are caused by postural problems that can be remedied by checking the orientation of the pelvis.

5. **Attainment of maximum velocity**: Athletes should attain maximum controllable velocity several strides from the takeoff. This velocity should be maintained all the way through the takeoff. Deceleration should be avoided at all costs.

Plant Phase (2 steps prior to pole impact)

The Plant Phase occurs over the last 2 steps of the approach and ends at the instant of ground clearance. The plant is the single most important technical aspect of the vault. It is of utmost importance that athletes perfect their plant because all subsequent phases of the vault are highly dependent on a successful plant. The plant is the means by which the momentum developed on the runway is transferred into the pole. As the efficiency of the plant increases, a greater amount of energy will be transferred to the pole, allowing for
the use of stiffer poles and higher clearances. The primary objective of the Plant Phase is to create as large an angle as possible (between the pole and the runway) without sacrificing speed.

1. **Maintenance of maximum velocity**: The velocities achieved in the previous phase should be maintained. Other than the penultimate step, no deviations in sprinting mechanics should occur.

2. **Lowered center of mass on penultimate step**: The vaulter should lower their center of mass just prior to takeoff. By doing this, the athlete will be better prepared to raise the center of mass at takeoff. In the second to last step, the athlete should use a rolling foot contact, striking heel first with a dorsiflexed foot. The athlete’s center of mass should lower slightly without postural deviation or deceleration occurring.

3. **Top hand curl to ear and press overhead**: The vaulter’s top hand should be curled to a position next to the ear and then pressed overhead. Both hands should move both forward and upward into the plant position. The curl should occur on the penultimate step; and the press should be completed as the takeoff foot makes ground contact. The pole should never be swept from the hips to the overhead position in an arcing motion.

4. **Tall extended body position prior to impact**: As the pole hits the back of the box, the vaulter should finish their plant in an upright and “tall” position. The top hand, head, shoulders, and hips should be in a vertical line. The takeoff leg should be fully extended. This position will create the greatest possible angle between the pole and the ground and reduce the angle the pole must rotate before hitting a vertical position.

5. **Triangle position**: The triangle position refers to the triangle formed by the vaulter’s top arm, lower arm, and the pole (Fig. 2). Both arms should be fully extended and the lower arm should be braced for impact. The athlete should press the bottom hand upwards rather than outwards. This will aid in the vaulter’s ability to transfer energy to the pole.

6. **Chest and shoulders square to takeoff**: The vaulter’s chest and shoulders should be completely in line and parallel to the plant box. This is important not only for the efficient transfer of energy to the pole, but also to maintain a neutral position in the core muscles for the subsequent upswing.

7. **Jumping into takeoff**: The athlete should actively jump into the takeoff. Ideally, the athlete will make ground clearance before the tip of the pole hits the back of the box. This ensures the most efficient transfer of energy from the approach run to the pole.

8. **Active drive of non-takeoff knee**: The free leg knee should be actively driven forwards and upwards. A forceful knee drive in the takeoff will increase impulse production against the ground.
Takeoff Phase (post-impact)

The Takeoff Phase begins the instant the vaulter makes ground clearance. The horizontal energy achieved in the approach is converted to vertical energy in this phase. The objectives of this phase are to load the pole with as much energy as possible, create the correct axis of rotation and rotate the base of the pole to vertical.

1. **Blocked non-takeoff knee position:** The blocking action of the free leg knee will “un-weight” the vaulter and allow for a more efficient transfer of the ground reaction forces to the athlete.

2. **Extension of takeoff leg:** The takeoff leg should remain in an extended position. By keeping the trail leg long, the vaulter prevents an early upswing. It also effectively keeps the vaulter’s center of mass low and close to the axis of rotation (the box); thus speeding the rotation of the pole to vertical. The vaulter should avoid breaking at the hips during this phase.

3. **C-Position:** At impact, the vaulter should feel their hips and shoulders move forward of their plant. This will create a “C-position” as the top hand falls behind the head and the takeoff leg stays long and behind the body. This will activate a stretch reflex in the shoulders and hips that will aid in the Swing to Inversion Phase. The athlete should continue to press the left hand up rather than out. The left arm can bend but should not collapse during this phase.

Swing to Inversion Phase

Proper execution of the upswing is critical for the vaulter to achieve a vertical position on the pole and maximize their hip height. The objectives of the Swing to Inversion Phase are to minimize the pole’s resistance to rotation, increase the vaulter’s speed of rotation, and vertically align the vaulter with the pole.

1. **Dynamic swing of trail leg:** The takeoff leg should be driven down and forward until it is brought in line with the top hand, shoulders, and hips (Fig. 3). The vaulter should not break at the hips until the top hand, hips, and feet align and point down to the box (Fig. 4). From this position, the legs and hips continue moving forward and upwards. A dynamic leg swing helps to get the vaulter inverted and close to the pole.

2. **Top hand pulls to feet:** This step occurs simultaneous with the dynamic trail leg swing (Fig. 3). The top hand arm should remain straight and pull in a sweeping motion down towards the hips and feet. The pole should be pulled close to the vaulter’s body. This is important for all subsequent actions. If the pole is kept far from the body, the athlete will not have enough strength to complete the row or the push and turn.
3. **Rowing action up the pole**: Once the vaulter’s top hand has been pulled to the feet, the vaulter should pull themselves up the pole with a rowing action of the arms. Because of the diagonal alignment of the pole against the vaulter’s body, the vaulter will naturally begin to turn around the pole. This action should be fast and occur simultaneously with the unbending of the pole. When executed in this way, the athlete can take advantage of the “lift” that the unbending pole will provide.

4. **Vaulter achieves vertical alignment with the pole**: The vaulter’s body should be close to and in line with the vertical pole. This is an important point if the athlete is to successfully execute the push off the top of the pole. If the athlete is far away from the pole then they will be in a much weaker pushing position than if they were close to the pole.

**Push and Turn**

The Swing to Inversion Phase flows seamlessly into the Push and Turn Phase. Like the previous phase the steps in this phase must occur very fast and almost simultaneously so as to take advantage of the “lift” of the pole. The objective of this phase is to maximize the vaulter’s hip height off the top of the pole.

1. **Simultaneous push and turn**: As the top hand reaches the sternum following the row, the vaulter should immediately begin the push and turn. This step must be timed to occur as the pole unbends. The unbending of the pole will effectively un-weight the vaulter and throw them upwards. Without that assistance, the vaulter would essentially be forced to do a handstand pushup to complete this phase. At the conclusion of the push and turn the athlete should be upside down and facing the crossbar.

2. **Full extension off the top of the pole**: The bottom hand must be released from the pole and the top hand arm should extend fully. The pole should be pushed down into the box and slightly back towards the runway. This will push the vaulter’s hips higher and get the pole out of the way of the standards, crossbar, and falling vaulter. This step can only be executed if the previous two steps are correctly executed and the pole is sufficiently stiff.

**Bar Clearance**

All of the preceding steps are aimed at getting the vaulter as high in the air as possible. The objective of the Bar Clearance Phase is to ensure that this height in the air is not wasted by a dislodged bar and unsuccessful attempt.

1. **Pike position**: Once the vaulter has achieved full extension of the top hand, the vaulter should pike at the hips over the crossbar. In so doing, the vaulter moves their center of mass outside of their body, allowing them to make higher clearances.

2. **Hollow chest**: As the athlete rotates around the crossbar, the athlete should “hollow out” their chest. This flexion of the upper back gives the vaulter a few additional inches of clearance before the upper body is withdrawn.

3. **Successful withdrawal of upper body**: Once the hips and mid-section have passed the plane of the crossbar, the vaulter should rapidly withdraw the upper body. This occurs as a result of back extension and the backwards movement of the
arms. This will allow the vaulter to clear their upper body out of the way of the crossbar.

**Practical Application**

The technical model can be used as a reference for correct technique. This application would be useful in everyday practice as a means of identifying and correcting mistakes. As previously mentioned, the technical model places a great deal of emphasis on the approach and plant. As such, these should be the focus when coaching a pole vaulter.

**References**


## Technical Model for the Pole Vault

### Acceleration Phase (first 4-6 steps)
1. Top hand held at hip; bottom hand at sternum
2. Push the pole
3. Acceleration mechanics
4. Relaxed upper body
5. Smooth acceleration

### Transition Phase (middle 4-6 steps)
1. Transition to sprint mechanics
2. Gradual pole drop
3. Bottom hand acts as fulcrum
4. Relaxed upright upper-body
5. Attainment of maximum velocity

### Plant Phase (2 steps prior to pole impact)
1. Maintenance of maximum velocity
2. Lowered center of mass on penultimate step
3. Top hand curl to ear and press overhead
4. Tall extended body position prior to impact
5. Triangle position of arms and pole
6. Chest and shoulders square to takeoff
7. Jumping into takeoff
8. Active drive of non-takeoff knee

### Takeoff Phase (post-impact)
1. Blocked non-takeoff knee position
2. Extension of takeoff leg
3. C-position

### Swing to Inversion Phase
1. Dynamic swing of trail leg
2. Top hand pulls to feet
3. Rowing action up the pole
4. Vaulter achieves vertical alignment with the pole

### Push & Turn Phase
1. Simultaneous push and turn
2. Full extension off the top of the pole

### Bar Clearance Phase
1. Pike position
2. Hollow chest
3. Successful withdrawal of upper body