This work aims to identify the key flow parameters that influence flame acceleration in a semi-confined square channel. A transverse fluidic jet was used as an active flow blockage mechanism and to introduce turbulence into the propagating flame. Three experimental parameters were used to examine the relative influence of (1) mixture reactivity defined here as system equivalence ratio (SER), (2) jet mixture composition (JMC), and the momentum ratio (MR) on the acceleration of laminar premixed methane flame. High-speed PIV and schlieren photography were utilized to characterize the instantaneous flow-field conditions throughout the flame-jet interaction. Using these diagnostic techniques, flame front positions and local velocity vector fields have been spatially and temporally resolved. Changes in flame properties including flame structure, velocity, and vorticity were tracked as a function of time. Stoichiometric equivalence ratios were more effective in the production of vorticity and the promotion of flame acceleration. The stoichiometric condition accelerated the flame to the highest final flame velocity of the three parameters examined. Different compositions of the jet mixture demonstrated that the flame acceleration is primarily affected by the jet turbulence and not on the reactivity of the jet compositions. Out of the three parameters examined, the momentum ratio parameter had the least amount of influence on the flow field and flame acceleration. The increase of 33% in the momentum ratio had negligible effect in the final flame front velocity and implies that the jet turbulence is the main driving mechanism for flame acceleration.