Abstract: Development and application of advanced engineering tools - for description, prediction and optimization of the 2-stroke Diesel engine process - is essential for development of the marine engines of the future. Here, recent developments of optical and laser based imaging tools will be presented. Such tools can lead to both increased understanding and predictive capabilities of for example the scavenging process, fuel spray structure, flame ignition, and thermal loads. For optical studies access to the combustion chamber has been achieved using sapphire windows, mounted in starting air and fuel injector ports on both standard fuel oil and gas cylinder covers, or inserted in the 24 optical ports of a dedicated optical cover. A few examples, highlighting the new capabilities thus offered, will be presented. High-speed imaging offered detailed views of the dynamics of fuel jet ignition. Pulsed laser illumination was used for visualization of fuel jets, from which information on fuel jet penetration, jet velocity, and spray angles could be gathered. For this purpose a high-power laser and a custom designed imaging system was mounted directly onto the optical cover. The fuel jet data is qualitatively compared to results from KIVA simulations, in order to tune spray parameters in the numerical model. The same laser system was also used for measurements of in-cylinder flow velocities, in order to characterize swirl and scavenging. Particle image velocimetry (PIV) was used for those velocity measurements. Finally, infrared imaging was employed for two purposes, firstly for capturing the evolution of piston temperature distributions during single engine cycles and secondly for visualization of scavenging of hot product gases.