The standard model of particle physics provides a coherent description of high-energy physics processes and has been hugely successful in providing experimental predictions. Among the long list of predictions realised to-date by this theory, the most significant is arguably that of the discovery of the Higgs boson in 2012. The discovery of this particle half a century after being theorised provided the last cornerstone needed for the standard model to become fully consistent. Despite these huge successes, the standard model suffers from major shortcomings due to both internal theoretical issues and the inability to explain some phenomena. On the path leading towards a better understanding of particle physics, an in-depth precision study of the Higgs boson and its properties is crucial. One measurement of interest is the combined production of two Higgs bosons allowing for a direct handle on the Higgs self-coupling parameter of the standard model. This relentless work of characterising the properties of the Higgs boson is currently being undertaken at the Large Hadron Collider, where high-energy proton collisions are being recorded by dedicated detectors, providing a continuous improvement to the understanding of the standard model. Amid these tremendous achievements, some processes, including the Higgs boson pair production, remain too weak to be detected with the current installations. To maximise the physics reach of the accelerator, it was decided to subject the installations to a major upgrade, thus allowing a strong increase in instantaneous luminosity. Such a dramatic change will bring major challenges to the experiments recording these collisions and upgrades are required if they are to maintain their outstanding performance. This thesis explores the upgrade of the CMS silicon strip detector, centred around the in-beam characterisation of detector module prototypes and discusses the physics reach of the upgraded machine, with an emphasis on Higgs boson pair production in the bbWW(lνlν) final state.