Thermal spray processes, to create surfaces on working engineering artefacts with enhanced resistance to wear and corrosion, have advanced significantly in recent years. It is now becoming possible to modify the surfaces from an almost infinite range of materials, to design - in specific properties - to faithfully fulfil the optimized desired engineering purpose or function. Among all the thermal spray processes, the powerful potential of plasma spraying to create hard tribological coatings has been well recognized and exploited. However, in many of the demanding applications, the low tensile bond strength and the high porosity characteristic of plasma sprayed coatings have limited their use. Detonation coating is an exotic process, which answers to this problem well both from performance and economic points of view. Perhaps in order for acceptance of such coatings/treatments, there is need to establish, evaluate and implement appropriate and universally accepted quality assurance and control procedures. Therefore, quality assurance must be seen as a central element in such spray systems, with particular measurable properties and characteristics, which in turn faithfully impart the desired performance.

Statistical process control techniques are being used to improve the coating quality by optimizing the spray parameters and to understand relationship between the spray parameters and coating properties. Currently, there is a proliferation of papers in the research literature extolling the benefits of plasma and high velocity oxyfuel spray systems, utilizing the optimization studies. However, the potential of these studies has not been exploited in the case of detonation gun spraying.

In view of the perceived advantages of detonation coatings over plasma spray coatings, a major programme to develop high quality alumina coatings has been initiated. This thesis contains a combined experimental and statistical analyses of alumina coatings deposited by plasma and detonation gun spray processes. Different mechanisms of wear, which are typically encountered in the industry and some fundamentals of thermal spraying, with brief introduction to plasma and detonation gun spraying are also addressed.
In the survey of literature section, a comprehensive review of comparison between the properties and performances of plasma and D-gun sprayed alumina coatings is presented. The utilization of design of experiments (DOE) studies in the plasma and vacuum plasma spraying are reviewed. Powder characterization, spray procedures and coating characterization including properties and performance evaluation tests are discussed at length, under the section of experimental details. A study for establishing the need for, and the role and the importance of the optimization techniques in plasma and detonation gun spraying is presented in Chapter IV. Included are description of Taguchi design and analysis, characteristics and performances of plasma and detonation coatings and significant process variables influencing the coating quality and their optimization. Particular emphasis is given to the splat formation dynamics and wear mechanism under separate sections.

The purpose and primary aim of the present thesis is to explore the potential of the detonation spray systems for commercialization and for process improvement. Hence, greater attention has been focussed on the detonation gun spraying in the final section of this thesis. The possibility of producing high quality coatings, with a commercially available (in INDIA) and low cost alumina powder using Taguchi design of experiments has been explored.