CHAPTER 3

RESEARCH OBJECTIVES AND METHODOLOGY

3.1 OBJECTIVES

In this study, both geometry setting and process optimization are integrated to obtain maximum productivity with appropriate dimensional quality. As per the previous studies, the minimum number of spots required to set geometry between any two parts are ‘2’, Kristina [36]. Further investigations have been done in this study by considering four major factors to define the applicability of optimizing the number of geometry spots across body shops with different configurations.

The following are the main objectives and scope of the study.

- To identify the minimum number of geometry spots required to set geometry in sub-assemblies of an automobile body to ensure appropriate dimensional control
- To evaluate the accuracy of spot allocation through validation experiments
- To study the effectiveness of appropriate spot allocation on productivity improvement
- To investigate the overall benefits in equipment reduction, space optimization, cycle time reduction and inappropriate process wastage elimination
- To develop an application program in CATIA V5 software platform for industrial application
3.2 MOTIVATIONS FOR GEOMETRY STATIONS REDUCTION

In addition to the said objectives, there are few other major reasons which have motivated the investigation to work on reduction of the geometry stations in body shop. They are as follows:

- In a flexible production shop, the geometry stations are mostly dedicated to a specific model; whereas re-spot fixtures are shared as a common tool for as many models as possible. It indicates that geometry fixtures are required in larger quantities for multi model shops. There is a need to resolve this concern through geometry fixture reduction study and commonize maximum re-spot stations across models. In a Nissan automobile production plant, two bodies are manufactured in the same plant but are produced on two different production lines. The production lines are subdivided into a similar cellular of "zone" concept, where various sub-assemblies of automobiles are manufactured [100].

- In a multi-model shop, the sub-assembly fixtures occupy more space in the shop layouts. The space constraint urges the process planner to either outsource the fixtures or to extend the building to accommodate the new fixtures, which in turn directly increases the capital investment requirement. Mohammadi has studied the design of dynamic body shop layout for automobile industry. The author has explained the space constraint issues in flexible body production line and cost requirements for rearrangement of layout for flexible production [101].

- The design and development cost of a geometry fixture is considerably higher than that of a re-spot fixture for the same assembly. Hence reduction of geometry fixtures will reduce the capital cost requirement.

By solving the given problem, multiple problems of a body shop can be optimized.
Overview of the research methodology is given in figure 3.1

3.3 RESEARCH METHODOLOGY

Study of Appropriate spot allocation between the geometry and re-spot stations to improve quality and productivity

Preliminary study to identify the potential benefits of the study

Analysis of existing conventional process planning and identification of the gaps

Development of a scientific methodology to distribute spot welds among the stations

Identification of minimum spots required to set the geometry through an experiment

Formulation of a set of experiments using “Design of Experiment with L27-Taguchi method”

Preparation and welding of samples with different spot weld configurations. Analysis of dimensional variations at pre-weld and post re-spot weld conditions through measurements using CMM

Validation of the accuracy of the distribution model with a controlled experiment

Identification of the minimum required spots for different surface contacts

Development of a Geometry spot distribution model with the experiment results

Validation of the model by application in real world samples of different body shops

Test results

Development of a 3D software program for automated geometry Spot assignment in the product architecture

Figure 3.1 Research methodology