[4] Hypothesis:

As above mentioned objectives and introduction the following hypothesis are made:

- In India, from last three to five years, there is tremendous growth in the infrastructure industry and construction industry as well as the manufacturing industry; those are concerned with the manufacturing of construction equipments and machineries. As mention earlier in first section, as per detailed review on the Indian market for backhoe excavator was briefly covered in Off-Highway Research’s Multi-Client Study on India in October 2007, which also shows that, there is a big market circle for manufacturing of back hoe excavators with best economical price.

- As per Off-Highway Research’s Multi-Client Study, the backhoe excavator market has been growing continuously for the last six years at a very impressive rate. With rapid urbanisation, GDP growth at over nine per cent and a government focus on developing the country’s infrastructure, the forecast for backhoe excavator demand is very positive indeed, and the market is expected to reach a level of 52,000 units by 2012. As a result, many new manufacturers, both domestic and international, are looking at entering the lucrative backhoe excavator market.

- An analysis of the origins of India’s GDP shows that services and industry sectors are the main drivers of growth, whilst the importance of agriculture is decreasing year on year. The government’s focus on infrastructure development. Due to this result, the market is open for new manufacturers for manufacturing excavation machinery like back hoe excavators with small capacity.

- The backhoe is by far the most popular construction machine in India, accounting for around 45 per cent of the mobile construction machinery market. It is also the fastest growing market across the whole Indian construction equipment industry. Sales of backhoe loaders in India reached almost 22,000 units in 2007, a growth of over 58 per cent compared to 2006. In the last ten years, the backhoe loader market in India has grown more than tenfold from 2,172 units in 1998 to 21,769 units in 2007.

- The table 1.1 shows the comparison of production of backhoe excavators by manufacturers, during the period 2003 to 2007. This comparison shows that, tremendous growth of manufacturing of the backhoe excavator and remains open for next coming years for long period.

- In this study, the proposed dimensions (working range) of mini hydraulic backhoe excavator attachment are decided based on market survey and reverse engineering and the 3-D model will be develop using the CAD modelling software.

- Comparison of the various models of backhoe excavators is carried out and finalized the required major technical specifications to carry out the successful digging operation. These required data collected from the prospectus and sites of the excavator manufacturing company.
• Calculation of the soil resistive forces/excavation forces will be based on the Fundamental Earthmoving Equation (FEE) described by Reece, for horizontal terrain and inclined terrain and using other soil-tool interaction models.

• Bucket capacity, bucket rating, bucket struck capacity, Pay load, soil fill factors and digging force calculations will be based on the SAE standards. Some of the data related to soil are based on research work carried out by other researchers and their authentic publications and research papers.

• Backhoe attachment consider with the 4-DOF. The kinematic solution of the arm and boom will be in the form of homogeneous transformation matrix by using Denavit-Hartenberg (D-H) notation. The proposed dynamic model based on the Lagrange-Euler formulation and will be validated against the dynamic model developed by Koivo (1994) using Newton-Euler formulation.

• Stress analysis will be carried out for proposed model of backhoe attachment without compromising its strength using FE Analysis.

• Most of the hydraulic excavator backhoe attachments are manufacture for robust applications with higher factor of safety, which lead to increase the cost of excavator but the proposed model will be optimize for weight to reduce the initial cost, operating cost in terms of fuel consumption and for better performance for autonomous applications.

Herein the greatest opportunity for development of optimized design of backhoe excavator attachment with most economical consideration particularly for light duty construction work and which is beneficial for small as well as medium scale earthmoving and construction industries. This research work will helpful to the SMEs to increase the sales and service in the field of the excavator manufacturing and its maintenance.