Chapter 1

Problem Definition
1.1 Introduction –

Man used stone as a tool for hunting and started journey towards the innovative thinking long time back in 1,750,000 B.C. This made human to get distinguished from animals and insects.

One of the major features which distinguished man from other animals is there bipedal posture and stability while walking on two feet. As the hind limbs progressively took over the loco motor functions, the vertebral column assumed a new role. No longer it was horizontal (like cats, dogs), it became vertical weight bearing rod. Further this rod developed as a column of flexible elements in various directions to provide flexibility in movement as well as stability against gravitational force. Morton (1) explained the posture of any animal as a result of forces interactions it experienced e.g. internal muscle forces versus external gravity forces.

The adoption of erect posture gave human flexibility and agility but at the price of reduced stability and speed. This is due to raised Center of Gravity (COG) and reduced supporting base (foot). To overcome this, there were lot of evolutionary changes in development and adoption of spine, hind limb (legs) connectivity to spine as well as joints in hind limbs like pelvic, knee and foot joint. Muscles were also developed so as to stand, walk, run as well as jump. When man understood to stand erect, he also learned to sit or lie down. This helped lower COG. This resulted in less work done against gravity and relaxation. Any change in posture like lying to sitting or sitting to standing is a very complex coordination of movement within the body so as to maintain the overall stability of body weight.

To overcome the disadvantage of stability and speed man further developed wheel which helped him to have movement in most stable seated position. Man
also landed on the Moon as well as could drive vehicle on the Mars. There was also significant progress related to space walks, communication, Nanotechnology and so on. Invention of wheel, engine or motor vehicle was also major milestones in human development. It provided connectivity associated with convenience.

Sitting is more stable posture (low COG) than standing. It also frees fore as well as hind limbs (hands and legs) for other tasks. Due to this, sitting was preferred and predominant posture when man started performing additional tasks while in motion like using sword while horse riding, operating cranes or operating controls while driving. Slowly driver became integral part of vehicle architecture and his/her comfort a predominant requirement in vehicle design. In today’s world transportation devices like bicycle, two, three, four wheeler, trains, ships or air planes has become integral part of life and is considered as necessity rather than luxury.

1.2 Objective of the Thesis

Decision to buy a vehicle generally depends on driving comfort, subjective opinion through advertisement or mouth publicity. While designing a vehicle driver position has always been a key element. With the growth of automobile industry, many researchers were attracted towards the study of driver positioning and its various aspects. Some of the vehicles do show compromises for rear passenger comfort (sport cars) or extra comfort provisions for rear passengers (limousines). These compromises are predefined based on rear seat occupancy percentage and product positioning in the market.

The driver’s compartment, however, has more demanding concerns or expectations irrespective of the vehicle class or population mix. Drivers, in a wide range of sizes, proportions and skills, must be able to position themselves comfortably for vision, and control operations regardless of the vehicle class, styling and cost.
When a designer decides driver’s position in newly designed car or a marketing person wants to predict how to use this as a selling feature this study does not provide a logical clue between subjective feeling of a best seating posture and objective engineering analysis till somebody produces first prototype and tests it against competition. Many a times this is due to the fact that customers describe the feeling through colloquial language like wow, soft, sinking numbness etc while engineers / technicians try to interpret them in engineering terms like acceleration, Kgs, Hzs and so on. While designing a new car, designers try to collect voice of customer or subjective ratings from potential customers on competitors’ vehicles of similar category for better understanding. Although this is a useful technique, customer expectations change based on products available in market. Competition also changes during development of newly designed car.

European driver needs to concentrate on vehicle ahead and signage provided on road while Indian driver needs to concentrate not only the vehicle ahead but also pedestrians, animals coming from sides and overtaking vehicles as every body uses crowded road same time.

Research also shows that uncomfortable seats results faster fatigue conditions and may result in permanent disabilities like low back pain, lower body numbness as well as sometimes sever accidental situations. Driver’s seat is maximum time utilized whenever the vehicle is on the road. Driving also is a multi decision task which can result in fatal accident situation in case of reduced / driving attention.

Designers / engineers carry various experiments to understand rating of one concept/ attribute/ car over other. To establish whether the vehicle is comfortable from driver’s perception subjectively as well through objective experimentations will be useful. It will be also necessary to find correlation between this subjectivity to objective rating so that one can use either of the methodology to find most
comfortable vehicle or assess newly developed vehicle in early development phase.

1.3 The Methodology –
1.3.1 Present scenario–

At present most of the car manufacturers use relative grading of various cars for driving comfort based on some standard scale, mainly 1 to 10 scale for rating the car from worst to best in class. Either the study is carried out on group of potential customers or internal test engineers.

1.3.2 Subjective Evaluation –

Many companies also use test engineers or drivers who are sensitive to driving, who generally drive the vehicles for longer duration for testing or by habit. To increase their sensitivity further, mostly this group of people is exposed for variety of vehicles so that they can get feel of worst and best in class judgment. Since this exercise can not be conducted on a particular day as well as all people may not be available every time, the chances of variation in their judgment can not be denied and unless there is fully developed car for evaluation these people may not able to evaluate it against the bench mark cars.

1.3.3 Objective Evaluation –

Any new vehicle development program takes 36 to 40 months during which one may receive prototype part, concept or local assembly very early in the program. Getting fully finished vehicle may take more than 24 months. At this time, in case if there are drastic changes or reiteration of basic concept it results in major time shift as well as loss of investment incurred till then. This problem of chicken or egg first occurs almost for every newly developed car for sensitive issues like driving comfort which is a key buying attribute for the customer.
1.3.4 Need to find Correlation-

Looking at this situation it is evident that it will be useful to generate a procedure which is suitable for normal development cycle, easy to operate and reliable to predict for issues like driving comfort. In early stage of car development program there are many concepts which are evaluated based on some objectively measurable performance parameters to take it forward for detailing. The experiments conducted are either through soft CAE, drafting methodologies or simple indoor test methods. Even though the results may be good for individual attribute or component it is difficult to predict how it will be seen with fully finished car. There are also situations where these attributes are interrelated and need to be balanced to get optimum solution.

At present there is no software or procedure by which one can balance these findings to convert local optimum design concept to global maximized performance attribute. This also needs to be checked for perceptional feeling of the end user before declaring it as reliable method.

The research work aims at establishing subjective rating of different vehicles for driving comfort, objective measurements of various attributes. These two are then simulated to find out relationship between these findings.