The basic structure and skin of an automobile, truck or bus is most typically made by stamping of sheet steel in a series of matched-tool forming operations. The push for lighter weight vehicles has led to the development of alternatives, starting with aluminum and more recently to short fiber thermosetting composites (e.g. outer body panels for the Saturn) and Long woven fiber composites produce with resin transfer molding (e.g. the Dodge Viper).

In this problem you are to address each of these materials and attendant processes and discuss the details of the specific processes, how each material reacts to the process, and how the processes compare in various aspects of manufacturing. In particular, we want you to address the following materials and processes:

1. Conventional Sheet Steel Stamping
2. Aluminum Sheet Stamping
3. Injection Modeling of Short Fiber Thermoplastic Composites
4. Resin Transfer Molding of Long Fiber Thermosetting Composites

For each of these four processes please discuss:

a) The basic process from the point of view of the material (i.e. what changes does it go through to achieve the desired part?) Please cite and discuss the dominant physical processes that determine the final shape of the part.

b) The tooling requirements (Please consider the mechanical, and thermal performance as well as the methods of producing such tools.)

c) The factors that influence part quality. Be sure to address those factors in the process that are most likely to cause variability.

d) The factors that determine or limit the production rate. Please be specific.

e) The factors that influence the cost of the resulting panels, both on a per unit basis and over a large volume of production.

f) The implications of each of these in a factory system where the following are of concern:
   Overall throughput
   Effect of disruptions (including repair times)
   Changeover time

g) How the resulting panel will perform in service compared with conventional steel panels

Finally, please create a comparison table that rates each method on a relative basis, using the steel case as the baseline. The table should include:

- cost,
- production rate
- quality
- flexibility