electromagnetic fields are using the different planes of the material.

c. Dielectric Constant was determined by a very specific test method which may or may not correlate to the microwave application of interest. The Dielectric Constant which is reported for a material can be dramatically different by the test methods.
d. The permittivity behavior is mainly attributed to dipolar moments and relaxation. Different dielectric materials will have different properties related to the dipole relaxation time.
e. The low-end material such as FR-4 may have worse dielectric tolerance, moisture absorption, passive intermodulation (PIM), Dk/Df over Frequency and Temperature etc.
f. In the manufacturing process control, the most of manufacturers in mainland China still used and only used legacy TDR equipment such as Polar CITS500s Controlled Impedance Test System. They may do not have capability to use the proper test method for the microwave application of interest.
g. In the manufacturing process control, the manufacturers usually do not follow the material's datasheet. The impedance is controlled by achieving the different pressout thickness. They use copper thickness, copper area, resin, estimated dielectric constant etc. to estimate the desired thickness. The Prepreg's thickness may very under the different cure temperature and pressure. The Core's thickness will not be changed during the laminating process.

According to the manufacturers' capability, my strategy for controlling the PCB's Dielectric Constant is:

a. Specify the Part Numbers of the Core and Prepreg. Specify the PCB layer stackup and the total PCB pressout thickness.
b. Implement the PCB calibration kit with the transmission line