Dimensional variation in assembled products directly affects product performance. To reduce dimensional variation, it is necessary that an assembly be robust. A robust assembly is less sensitive to input variation from the product and process components, such as incoming parts, subassemblies, fixtures, and welding guns. In order to effectively understand the sensitivity of an assembly to input variation, an appropriate set of metrics must be defined. In this paper, three product-oriented indices, including pattern sensitivity index, component sensitivity index, and station sensitivity index, are defined. These indices can be utilized to measure the variation influence of a pattern, an individual part, and/or component, and components at a particular station to the dimensional quality of a final assembly. Additionally, the relationships among these sensitivity indices are established. Based on these relationships, the ranges of the sensitivity indices are derived. Finally, a case study of a sheet metal assembly is presented and discussed to illustrate the applicability of these metrics.