Design closure exploiting electromagnetic (EM) solvers has become one of the fundamental design tools in contemporary microwave engineering. For many structures, adjustment of geometry and/or material parameters can only be done through repetitive EM simulations because analytical design formulas either do not exist or can only provide initial designs that need to be further refined. Unfortunately, EM-driven optimization is a challenging problem with the major bottleneck being a high computational cost of accurate simulation. This problem can be alleviated by using fast and yet reliable surrogate models that can replace the CPU-intensive EM-simulated structure of interest in the search for optimum design. The surrogate models exploiting physically-based low-fidelity models (e.g., circuit equivalents) can be particularly efficient: the knowledge about the structure under design embedded in such a low-fidelity model allows us to dramatically reduce the number of EM simulations necessary to find a satisfactory design. Here, we review the concept of knowledge-driven design as well as specific design techniques, including space mapping, simulation-based tuning, and various response correction methods. Discussion on open problems and perspectives of these methodologies is also included.