The respect of the machined piece quality and productivity is closely related to the mastery of uncertain factors. Indeed, the efficient solutions obtained from the machining parameter optimization based on classical methods are assigned of uncertain deviations which affect the cutting process. In the present paper, we propose multi- and mono-objective optimization approach of parameter turning with taking into account both production constraints related to piece quality, to machine power, or to tool life, than uncertainty factors related to the tool wear and to piece geometry defaults. To this end, we developed and implemented an efficient genetic algorithm, based on an evaluation mechanism of “objective” functions, which integrate the Monte Carlo simulations to calculate the robustness of objective function and different constraints. Our approach has been validated by two applications implemented with Matlab™ for the minimization of cost and machining time, which has allowed obtaining simultaneously efficient and robust results and offering the possibility to choose beforehand a compromise between efficiency and robustness of solutions