results show easily that for high efficiency (s=0.005) there is an exponential growth of number of new technologies, and then of successful technologies, in accord to what it is expected by the R&D model when financing of R&D projects is not limited. For the high value of ISE, at the fourth cycle the calculated number of new technologies is of 2828 and successful technologies of 566, not represented as out of scale. Calculation made with a low ISE (s=0.0025) there is, considering six cycles, only a limited increase of new technologies and a small linear increase of successful technologies. Of course, the extremely high growth of technologies in a territory, observed for high ISE, is not realistic, and limitations of number of financed R&D projects could appear facing such high number of potential R&D projects, and another limitation may be simply constituted by lack of structures or human resources to carry out such huge number of R&D projects.

5 INFLUENCE OF PARAMETERS ON MODEL RESULTS

The influence of parameters on model results depends on how the model operates and, although it is only a rough simulation of R&D activity, it might suggest interesting observations about the real functioning of the R&D process. In fact, the model operates through a sequence of generative and selective process steps. Generative steps concern the combinatory process among information packages, constituted by general R&D knowledge GRDK, and external information, while the number of available R&D project proposals is determined by the innovation system efficiency ISE of the territory. Selective parameters determine the number of financed R&D proposals, the number of R&D projects generating new technologies, and the number of successful technologies appearing among the generated new technologies. All selective parameters induce a linear dependence between number of projects proposals and resulting number of technologies, while the generation process of innovative ideas induces an exponential dependence because of the combinatory process at the base of calculations. In fact, the presence of selective parameters makes the existence of a critical minimum number of projects and only above this number it will be possible the statistical generation of new or successful technologies. On the other side, the combinatory process makes the generation of R&D projects, and then new or successful technologies, an autocatalytic process of increasing growth. Experience in R&D activities demonstrates the validity of such results. In fact, it is well known that low investments in R&D give poor values of growth, while effective territorial innovation systems, joined with full availability of R&D investments, are able to make an exponential growth of technologies and positive socio-economic impacts, as observed for example in the case of Silicon Valley (Bonomi 2017). After these general aspects of parameters influence, it is also interesting to examine in detail the effects of specific parameters of the model related to the real situation of the R&D activity:

Generation of innovative ideas

The model of R&D activity (Bonomi 2017), and the present mathematical version, considers as main source of innovative ideas the GRDK formed in R&D activity joined with external information mainly of scientific and technical nature. The mathematical model treats such knowledge as an ensemble of information packages and new ideas are formed by a combinatory process of such packages. The origin of new technologies, by exploitation of scientific information with combination of pre-existent technologies, has been already considered discussing the nature of technology (Arthur 2009), and new technologies may be formed also by simple combinatory processes without recurring to specific scientific discoveries of new phenomena (Bonomi, Marchisio 2016). Such combinatory process is expressed mathematically by the model in equation 4. However, although information packages cumulate with time (number of cycles following the model), it is necessary to consider also a loss with time of such information calculable mathematically using a fading parameter. In equation 3, the model establishes the way it is treated the fading effect for calculation of the total information packages available for generation of innovative ideas. It should be noted that fading effects may be different following