

**Smart products and R&D : effects of the option to update**

Nick F.D. Huberts (1), Herbert Dawid (2), Peter M. Kort (3),

(1) School for Business and Society, University of York, Church Lane Building, Heslington, York YO10 5ZF, United Kingdom (2) Department of Business Administration and Economics and Center for Mathematical Economics, Bielefeld University, 33501 Bielefeld, Germany (3) CentER, Department of Econometrics & Operations Research, Tilburg University, P.O. Box 90153, 5000 LE Tilburg, The Netherlands

This paper considers the problem of a monopolist that can invest in R&D to improve the quality of a smart product (e.g., AVs). A higher quality directly results in a lower frequency of incidents caused by the AVs. The R&D process is uncertain both in terms of duration and outcome. In addition, the firm holds two (nested) options: the option to launch the product on the market and the option to update the product after launch. The firm chooses not only the timing to exercise its options, it also chooses its R&D intensity and production capacity size. We analyze the problem of the firm as well as the impact of measures by a regulator. In particular, we are interested in the impact of the option to update, and safety regulation, on the firm's R&D and investment strategy as well as the impact on the accident rate.

**Keywords:** Smart Products; Uncertainty; AVs; R&D; Capacity Investment; Real Options