

Capacity Oversizing for Infrastructure Sharing Synergies: A Game Theoretic Analysis

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Abstract : Industrial symbiosis (I.S) rely on two basic modes of cooperation between organizations that are infrastructure/service sharing and resource substitution (the use of waste materials, fatal energy and recirculated utilities for production). The former consists in the intensification of use of an asset and thus requires to compare the incremental investment cost to be incurred and the stand-alone cost faced by each potential participant to satisfy its own requirements. In order to investigate the way such a cooperation mode can be implemented we formulate a game theoretic model integrating the grassroot investment decision and the ex-post access pricing problem. In the first period two actors set cooperatively (resp. non-cooperatively) a level of common (resp. individual) infrastructure capacity oversizing to attract ex-post a potential entrant with a plug-and-play offer (available capacity, tariff). The entrant's requirement is randomly distributed and known only after investments took place. Capacity cost exhibits sub-additive property so that there is room for profitable overcapacity setting in the first period under some conditions that we derive. The entrant willingness-to-pay for the access to the infrastructure is driven by both her standalone cost and the complement cost to be incurred in case she chooses to access an infrastructure whose the available capacity is lower than her requirement level. The expected complement cost function is thus derived, and we show that it is decreasing, convex and shaped by the entrant's requirements distribution function. For both uniform and triangular distributions optimal capacity level is obtained in the cooperative setting and equilibrium levels are determined in the non-cooperative case. Regarding the latter, we show that competition is deterred by the first period investor with the highest requirement level. Using the non-cooperative game outcomes which gives lower bounds for the profit sharing problem in the cooperative one we solve the whole game and describe situations supporting sharing agreements.

Keywords : capacity, cooperation, industrial symbiosis, pricing

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