



## Improving new technology venture performance under direct and indirect network externality conditions

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### ABSTRACT

This study compares the effectiveness of five responses to external uncertainty in markets with network externalities: avoidance, imitation, control, cooperation, and real options reasoning as a form of strategic flexibility. Our analysis of 385 new technology ventures shows that direct and indirect network externalities have opposite effects on the effectiveness of these strategies. Moreover, under network externalities, attempts to make ventures less dependent upon environmental instabilities perform differently compared to attempts to control the environment. Finally, we show that real options reasoning does not always perform better under conditions of higher uncertainty, such as uncertainty due to direct network externalities.

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### 1. Executive summary

In some markets, the value of the firm's new product depends not only on the characteristics of the product itself, but also on the number of users that will eventually adopt it (direct network effects such as in case of Internet instant messengers and other social network-related software and apps) or the number of complementary products that would be available on the market (indirect network effects such as in case of Blu-ray players and Blu-ray disks, mobile devices with different operating systems and applications for them, etc.). Such markets are called markets with network effects, and launching a product there is a major challenge. The connected world, next to the advantages it brings, transforms a variety of traditional markets into markets with network effects. As a result, an ever increasing number of new technology ventures have to cope with uncertainty associated with such markets. Prior research shows that new products launched in markets with network effects tend to generate 25% less profit compared to markets without such effects. On the other hand, successfully enacting such network effects can boost ventures'

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performance. Therefore, new technology ventures should decide carefully which strategy in markets with which network effects they should choose.

In our study we focus on five main uncertainty management strategies firms can employ: strategic avoidance, strategic imitation, strategic control, strategic cooperation, and strategic flexibility. From the perspective of the resource dependence theory, the former four strategies represent efforts to increase the venture's control over its environment. The fifth strategy, strategic flexibility, represents adaptation intended to make the venture less dependent upon changes in its environment. In this study we focus on real options reasoning as a special form of strategic flexibility that is particularly relevant for new technology ventures.

We empirically investigated effectiveness of these strategies in markets with direct and indirect network effects using a sample of 385 NTVs drawn from the VentureOne 2001 database and the 1995–2000 Inc. 500 list. Contrary to our expectations, two strategies—strategic avoidance and strategic imitation—did not have a direct positive impact on NTVs' ROI. The other three strategies had an overall positive effect on performance that differed depending on the type of market the technology venture operated in.

Our results strongly support the distinction between the two types of strategies and two types of network effects. Looking at the significant interactions, real options reasoning had exactly the opposite moderating effects compared to the other four strategies (avoidance, imitation, control, and cooperation)—meaning that these two types of strategies behaved differently in both markets with direct and markets with indirect network effects. Another interesting finding is that when direct network effects strengthen the effect of a particular strategy, indirect network effects tend to weaken it, and vice versa.

Firms enact direct network effects by increasing the number of users of the firm's products. Our results imply that this can be done best by intervening in the market directly and that action delay is useless. This makes avoidance, imitation, control, and cooperation the best ways to deal with direct network effects. In order to take advantage of indirect network effects, firms need to increase the number of complementary products and services. Our results show that this can be best done by pursuing several product options (which may be complementary to each other) rather than by trying to directly influence other firms to produce complementary products for one of those products.

Finally, our study contributes to the real options literature by testing the theoretical proposition known as real options intuition: the higher the uncertainty, the greater the value of real options and the better they work. In our study “real options intuition” clearly does not hold in cases of uncertainty due to direct network effects. In particular, the effect of real options reasoning on both ROI and customer retention rate becomes worse when NTVs operate in markets with high *direct* network effects. At the same time, in line with the “real options intuition” proposition, real options reasoning indeed works better under uncertainty due to *indirect* network effects both in terms of ROI and customer retention rate. As a result, we identify two new sources of uncertainty that should be taken into account when deciding on the appropriateness of applying real options reasoning, thus redefining the boundaries of real options applicability.

## 2. Introduction

Among entrepreneurial firms, new technology ventures (NTVs) represent a special case, requiring as they do extensive research and development effort under uncertainty, i.e. unpredictability of the venture payoffs (Huchzermeier and Loch, 2001; McGrath, 1997; Miller, 1992; Pfeffer and Salancik, 1978). Researchers traditionally distinguish among uncertainty related to technology, customers, and other market players (Atuahene-Gima and Li, 2004; Bstieler, 2005; Huchzermeier and Loch, 2001; Li, 2008). While a relatively high level of technology uncertainty is common for NTVs (McGrath, 1997), the levels of other types of uncertainty may differ substantially from one venture to another. One possible source of this variation is network externalities, which represent a set of unique and increasingly important challenges for the ventures.

Research on network externalities often focuses on a particular industry (such as software) or market (such as videocassette recorders and videocassettes, DVD players and DVDs)—where existence of network externalities is evident (Brynjolfsson and Kemerer, 1996; Katz and Shapiro, 1986; Tanriverdi and Lee, 2008). However, recent studies show that both direct and indirect network externalities can be found in a variety of industries and markets, and that the levels of the externalities differ from one product category to another (Goldenberg et al., 2010a; Schilling, 2002; Srinivasan et al., 2004). With technological advancement, people become increasingly connected, transforming a variety of traditional markets into markets with network effects (Stremersch et al., 2010; Wuyts et al., 2010). At the same time, Goldenberg et al. (2010a) reported that in more than 80% of the cases the discounted profit of a new product was 25% less in markets with network externality effects compared to markets without these effects. Thus, more and more markets will show network externality effects, and those effects can have substantial destabilizing influences on the economic value of the venture's products, and thus on their financial performance and survival. It is therefore important to understand how NTVs can manage the direct and indirect network externalities.

*Direct network externalities* arise when the benefits a customer derives from using a product increase with the number of other users employing the same product, as in the case of fax machines, Internet instant messaging programs, or social networks (Katz and Shapiro, 1986; Schilling, 2002). However, before this takes place, the product's number of users must attain critical mass (i.e. a substantial number of users would have to become active in the network). Before critical mass is reached, customers tend to take a “wait-and-see” position and delay their adoption decisions, making it difficult for a firm to predict the eventual level of new product adoption (Goldenberg et al., 2010a; Stremersch et al., 2010; Van Slyke et al., 2007).

*Indirect network externalities* arise when complementary products or services are of importance for the value of the product, such as in the case of Blu-ray players that require movies to be in Blu-ray format, or more recently mobile devices with given

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