EFFECTUATION IN THE MANAGEMENT OF KNIGHTIAN UNCERTAINTY: EVIDENCE FROM THE *REALNETWORKS* CASE

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Abstract

Using an in-depth case study of the creation of RealNetworks, a leading internet firm specializing in streaming media, we test hypotheses based on causation and effectuation in entrepreneurship. Specifically, we demonstrate how RealNetworks used the three principles of effectuation embedded within *the logic of control* – (1) affordable loss, (2) strategic partnerships, and (3) leveraging contingencies – to deal with complex and multiple manifestations of Knightian uncertainties in its micro and macro decision environments.

Causal rationality, with its emphasis on maximizing expected return, and avoiding surprises through accurate prediction and comprehensive competitive analysis, has long served as the foundation for both research and pedagogy in economics and business management. But since Knight's thesis in 1921, *unpredictability* has been acknowledged as the basis for entrepreneurial profits. Yet, few alternatives to predictive rationality have emerged. The predominant alternatives consist of either: (1) assuming the existence of traits-based constructs such as *judgment* (Knight, 1921), *mother wit* (Olson & Kahkonen, 2000), and *entrepreneurial orientation* (Lumpkin & Dess, 1996); or (2) "throwing darts," i.e., the idea that lots of people try lots of different things, some succeed, and most fail. Major breakthroughs in our understanding of decision making in general (unconnected to Knightian uncertainty) have come mostly from disciplines such as psychology and cognitive science, where scholars have identified a slew of heuristics and biases in human problem solving (e.g. Tversky & Kahneman, 1982; Gigerenzer & Todd, 1999).

More recently, Sarasvathy (2001), building upon these successful approaches, and using well-received techniques of protocol analysis to study expert entrepreneurial decision-making, has articulated the existence and use of effectuation as a viable alternative to predictive rationality.[1] However, this work is yet to be subjected to a rigorous empirical test. The purpose of this study is to examine *whether, and to what extent, entrepreneurs in the real world build companies using effectuation*. Using an in-depth case study approach, we seek to understand the use of effectual rationality in the decision-events that led to the creation of the Internet-company RealNetworks.

[1] In attempting to understand how entrepreneurs cognitively solve problems involving Knightian uncertainty, Sarasvathy (2001b) used in-depth protocol analysis to discover that expert entrepreneurs (founders of companies ranging in size between $200 M and $6.5 B) inverted specific principles of causal reasoning. Moreover, these inversions together constituted a comprehensive new logic that forms a basis for the management of Knightian

The research question we attempt to address is the following: *How does an Internet firm such as RealNetworks manage Knightian uncertainty?* In other words, we examine the creation of RealNetworks in the face of "true" Knightian uncertainty and illustrate how the firm used effectual rationality to establish itself as one of the leaders (along with Microsoft) in the emerging streaming-media industry on the World Wide Web (the Web). RealNetworks, as described in detail later in the paper, dealt with a host of different uncertainties, many of which fall under the rubric of "true" Knightian uncertainty. Besides establishing the role of effectuation in the creation process, this in-depth case study of RealNetworks is also helpful in answering key issues identified by entrepreneurship scholars as central to the field, issues that the existing literature on entrepreneurship has failed to address adequately thus far – i.e., *how, in the absence of current markets for future goods and services, such goods and services get created* (Shane & Venkataraman 1999). As will be demonstrated in the paper, this particular issue occupies center-stage in the creation of RealNetworks.

Although several researchers have attempted to understand heuristics and biases in the decision making processes of entrepreneurs (e.g., Busenitz & Barney, 1997; Baron, 2000), no comprehensive decision models have emerged from this effort, nor have any models been shown empirically to apply to the creation of new firms in the face of Knightian uncertainty. It is here that we see the contribution of this study. In particular, we infer from our analysis of the RealNetworks case that the theory of effectuation does appear to integrate the earlier studies of a variety of heuristics used by entrepreneurs under the umbrella of a common logic.

We organize the paper as follows. We first discuss the concept of Knightian uncertainty and then provide a detailed theoretical discussion of the notion of effectuation. Following this

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uncertainty. Results showed that at least 74% of the subjects in the study preferred effectual to causal rationality over 63% of the time. 44% preferred effectuation at least 85% of the time.

discussion, we present a set of hypotheses for testing. We then describe our research methods and our qualitative empirical analyses of RealNetworks. We conclude with a section on implications.

MANAGEMENT OF KNIGHTIAN UNCERTAINTY

Making decisions in the presence of uncertainty is the essence of entrepreneurship, a fact documented by numerous scholars in economics (e.g., Schumpeter, 1934; Kirzner, 1979; Baumol, 1993) and entrepreneurship (e.g., McGrath & MacMillan, 2000; Van de Ven et al., 1999). It was Frank H. Knight's (1921) landmark thesis that put the issue at the very heart of entrepreneurship research. As Blaug (1996: 444) notes, "The beauty of Knight's argument was to show that the presence of true 'uncertainty' about the future might allow entrepreneurs to earn positive profits despite perfect competition, long-run equilibrium and product exhaustion."

Knight identified three types of uncertainty: The first one (now generally accepted as the notion of *risk*), consists of a future with a known distribution – only the particular draw that will actually occur is unknown; the second one (generally known by the term *uncertainty*), involves a future whose distribution is unknown, but can be *estimated* by studying draws over time; and the third one that Knight called *true* uncertainty (that is now known as Knightian uncertainty), consists of a future whose distribution is not only unknown, but *unknowable* (see Table 1 for a summary of the three types of uncertainty and techniques to deal with them).

Insert Table 1 about here

The key difference between Knightian uncertainty and the other two types is that Knightian uncertainty involves dealing with a future that has no discernible distribution whatsoever, not even *in theory*. In this case, therefore, neither the calculus of *a priori* probability nor techniques of statistical estimation can work. As Knight (1921: 225) himself explained

"there is no valid basis of any kind for classifying instances." To explicate this notion further, Knight (1921:227) discussed the example of an entrepreneur making founding decisions for a firm and contrasted this with examples of insurance risks and other types of uncertainties with (*a priori* or statistically) enumerable probabilities.

As noted earlier, several researchers in entrepreneurship and economics have identified the management of "true" uncertainty with the core issue of the existence, value and fundamental role of entrepreneurship as the driver of the economy. Economists, for instance, have argued the failure of neo-classical economics with its static general equilibrium framework to deal with this central problem (Blaug, 1996: 444) and hence as Baumol (1993: 12) puts it, "Virtually all theoretical firms are entrepreneurless -- the Prince of Denmark has been expunged from the discussion of Hamlet." A careful reading of the economics literature, however, shows that neither Knight nor others offer any solution for the problem of true uncertainty. But, instead Knight (1921: p.228) argues that:

> The ultimate logic, or psychology, of these deliberations is obscure, a part of the scientifically unfathomable mystery of life and mind. We must simply fall back upon a "capacity" in the intelligent animal to form more or less correct judgments about things, an intuitive sense of values. We are so built that what seems to us reasonable is likely to be confirmed by experience, or we could not live in the world at all.

Some recent studies, however, have unearthed an alternate logic (and psychology) that underlies such deliberations to overcome Knightian uncertainty.

THEORY AND HYPOTHESES

From a theoretical standpoint, the problem space for effectuation integrates the spaces identified by Knight (1921), March (1982), and Weick (1979), each of which is inaccessible to causal approaches. It is a space where prediction is impossible (Knight, 1921), goals are not pre-determined (March, 1982), and the environment does not independently select the outcomes (Weick, 1979). Effectual rationality opens up a traversible path in this apparent wilderness by

inverting the problem definition, solution process, decision principles and overall logic of causal rationality.

Problem Definition

Causal rationality assumes pre-determined well-structured ends and formulates the decision problem as one of discovering the best possible means to achieve those ends. Effectuation begins with a given set of means and seeks to create and select between possible ends. While causation focuses on what *ought* we to do given pre-determined goals and possible means, effectuation continually emphasizes the question, "What *can* we do?" given possible means and imagined ends. Causal reasoning uses techniques of analysis and estimation to explore and exploit existing and latent markets; effectual reasoning calls for synthesis and imagination to create new markets that do not exist *ex ante*, sometimes not even *in potentio*.

Solution Process

Causal reasoning proceeds inward by breaking given goals into sub-goals and sub-sub-goals to specific individual tasks. In contrast, effectual reasoning proceeds outward from individual actions and tasks to emergent outcomes and goals that become evident only in the unfolding of decision-action-events over time. For example, while causation processes would proceed from a pre-determined market to be captured by segmenting it and targeting one or two specific segments, effectuation processes would proceed from a single customer or strategic partner (discovered through the given means or even accidentally), to synthesizing a new definition for a possible segment based on the first customer, and then imagining and adding segments in a contingent manner to create a new market that did not exist at the beginning of the process. Figure 1 graphically presents the contrast between the two processes.

Insert Figure 1 about here

Decision Principles

Sarasvathy (2001a) articulates three commonly used causal principles of business decision making that get inverted in effectuation:

Affordable loss rather than expected returns: Causation models focus on maximizing potential returns for a decision by selecting optimal strategies. Effectuation pre-determines how much loss is affordable and experiments with as many strategies as possible with the given limited means. It prefers options that create more options in the future over those that maximize returns in the present. The extreme case of this is the zero resources to market principle (Sarasvathy, 2001a).

Strategic partnerships rather than competitive analyses: Causation models such as the Porter's (1980) five forces model in strategy, emphasize detailed competitive analyses. Effectuation emphasizes strategic partnerships and pre-commitments from stakeholders as a way to reduce and/or eliminate uncertainty and erect entry barriers (Garud, Jain & Phelps, 1998).

Leveraging contingencies rather than avoiding them: When pre-existing knowledge such as new technologies with known markets (an AIDS vaccine, for example) forms the source of competitive advantage, causation models might be preferable. Effectuation, however, would be better at leveraging contingencies that arise unexpectedly over time, particularly in the case of new technologies with unknown or multiple potential markets (radio gels, for example).

Underlying Logic

Since causation processes focus on the predictable aspects of an uncertain future, the logic for using such processes is: *To the extent that we can predict the future, we can control it.* Effectuation, on the other hand, focuses on the controllable aspects of an unpredictable future. The logic for using such processes is: *To the extent that we can control the future, we do not*

need to predict it. It is this latter logic that binds together the decision principles of effectuation and overcomes the problem of "true" Knightian uncertainty. This it does in a curiously paradoxical way: On the one hand, it eschews prediction altogether – i.e., eliminates the need for prediction; and on the other, it transforms the unpredictable into the nearly certain by "creating" the distribution. In other words, effectual logic interprets Knightian uncertainty (a future that cannot be predicted because its distribution does not exist in any formal or even hypothetical sense) to mean that the future can have any distribution we choose to give it, subject to constraints on our means at hand.

Insert Table 2 about here

There are three categories of means that effectual rationality begins with: Who the decision maker is, what she knows, and whom she knows (Sarasvathy, 2001a). The decision maker, of course, can be an individual, a firm or a group, or the economy or population as a whole. Table 2 summarizes possible means for effectuation at all three levels.

In sum, the foregoing exposition on the two contrasting theories of causal and effectual rationality can be summarized to yield the following hypotheses:

Hypothesis 1: *The firm creation process will begin with who the entrepreneur is, what he or she knows, and whom he or she knows, and not with a predetermined market.*

Hypothesis 2a: *Early decisions will involve bringing the product into customers' hands as quickly as possible without regard to detailed calculations of expected return.*

Hypothesis 2b: *Early customers will be chosen either randomly or through strategic partners, and not based on detailed competitive analyses.*

Hypothesis 2C: *The creation of the firm will follow an iterative and path-dependent process contingent upon (i) the initial relationships forged by the entrepreneur, and (ii) how this expanding network of stakeholders leverages unexpected events that occur thereafter.*

Hypothesis 3: *The strategies implemented by the firm will seek to control and create the market rather than to predict and follow it.*

METHODS

Approach

As noted earlier, we examine the creation of RealNetworks in the face of "true" Knightian uncertainty and attempt to illustrate how it used effectual rationality to establish itself as one of the leaders in streaming-media. We recognize that the entrepreneurial processes that RealNetworks employed to conceptualize and build a sustainable entrepreneurial venture can be unique and that such processes may be difficult to identify and measure. This raises the question: *How should researchers study unique phenomena and then generalize from such situations and circumstances?* In such cases, it is the underlying processes that are often generalizable and not the manifest unique phenomena (Tsoukas, 1989). The challenge here, therefore, is in identifying the processes, and the principles of rationality that underlie those processes, in the creation of RealNetworks and its establishment as the world's leading streaming media company.

That challenge is uniquely met by the case study methodology. In their excellent expositions of the design and methods used in high quality case studies, Yin (1994) and Lee (1999) explicate in great detail when and how case study methodology should be used. For example, Yin (1994:1) states: "In general, case studies are the preferred strategy when 'how' or 'why' questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context." He further specifies three parameters when case studies are particularly appropriate, all three of which form key elements in our current investigation: (1) there are more variables of interest than data points; (2) multiple sources of evidence are available in a converging and triangulating fashion; and, (3) prior development of theoretical propositions guide data collection and analysis.

In fact, high quality case study research, whether using single or multiple cases, has not only been used effectively for descriptive and exploratory purposes, but also for *explanatory* purposes including frame-breaking causal inferences about complex and important phenomena. For example, Graham Allison's *Essence of Decision* uses a single case study for an explanatory purpose (Allison, 1969). The strategy used by Allison involves comparing competing theories to the actual course of events and logically developing the best possible explanation for the phenomenon, in his case, the Cuban missile crisis. In our research design, as also in subsequent analysis and inference procedures, we carefully build upon these and other guidelines for a high quality case study specified by reputed scholars and methodologists in the social sciences.

Similar to Yin (1994) and Lee (1999), Campbell (1975) also endorses the idea of "pattern matching" as a promising approach to doing explanatory research using single-case studies. Pattern matching involves relating several pieces of information from the same case to some theoretical proposition, preferably to propositions from two or more *rival* theories. In our research design, as also in subsequent analysis and inference procedures, we carefully build upon these and other guidelines for a high quality case study specified by reputed scholars and methodologists in the social sciences.

Choice of Firm

The choice of RealNetworks was deliberate. We chose this firm because: (1) of its pioneering role in its technology space, i.e., audio and video streaming media content on the Internet; (2) of the extraordinary attention that this firm has managed to attract in the media for its approach; and, (3) as an established entrepreneurial venture, RealNetworks exemplifies the phenomenon of interest, i.e., how an entrepreneurial firm dealt with true Knightian uncertainty in its attempt to establish itself as leader in the new economy.

RealNetworks is not a typical e-commerce firm; rather it is an exemplar. And as such, it has been (and continues to be) featured in Business Week, Fast Company, Forbes, Fortune, Inc, The Economist, The New York Times, The Wall Street Journal and several Internet-related publications such as Wired, Internet World, and Red Herring. This attention is also reflected in the successful initial public offering (IPO) of company stock made by the firm in September 1997. In other words, we chose this firm because it is "unique" and provides us the opportunity to observe and analyze a phenomenon previously inaccessible to scientific investigation. Thus, RealNetworks is an example of a firm that can be viewed as a "revelatory case" (Yin, 1994).

RealNetworks is also particularly apt for the research design for this study, given our choice of the case study method. Our perspective and goal is to identify a "phenomena in the making." Since factors influencing organizational processes often include path dependencies that are cumulative and historically conditioned (Arthur, 1988; David, 1985; Luhmann, 1990), a research design for generalizing about uniqueness needs to be longitudinal. Moreover, the design must enable the multiplicity of factors that may have shaped the process to be teased out and linkages to be delineated. A case study approach involving RealNetworks seems rather well suited for a study of this nature. RealNetworks managed to weather the stock market bubble and crash of the Internet economy, and provides us with continuous data spanning the period before, during, and after that crash.

Finally, our emphasis is on "analytical generalization" as opposed to the traditional "statistical generalization" (Yin, 1994). According to Yin (1994) statistical generalization is about making inferences about a population (or universe) using empirical data collected about a sample. We commonly recognize such an approach to generalizing "because research investigators have ready access to formulas for determining the confidence with which

generalizations can be made, depending mostly upon the size and internal variation within the universe and sample" (Yin, 1994: 30). In contrast, in case studies "the method of generalization is 'analytic generalization,' in which a previously developed theory is used as a template with which to compare the empirical results of the case study. As will become evident from the analysis, RealNetworks provides an ideal test bed for such analytical generalization.

Data Collection

Following Campbell's (1975) dictum that multiple sources of inference about a phenomenon are analogous to degrees of freedom in statistics, we used multiple sources of data including industry reports, business publications, and interviews. Our primary sources of data were: (1) accounts of actions provided by the firm in the form of press releases; (2) media accounts of these actions in the form of magazine and newspaper articles; and (3) financial analysts' reports (both on firm and industry). We also consulted several books (e.g., Reid, 1997) and a 3-hour documentary of the Internet.

Additionally, we interviewed respondents from the firm and domain experts from various Internet-based streaming media consortia. We also interviewed these industry experts about their understanding of the wider mosaic of ideas and forces that have enabled RealNetworks to establish a pre-eminent position as media streaming company on the Internet. Doing so also enabled us to get both "internal" and "external" perspectives on how RealNetworks evolved as the leader in this domain.

To gather industry related background information, we relied on multiple sources such as Internet World, an industry trade magazine, and the Lexis/Nexis electronic database. As typical in inductive research (Brown & Eisenhardt, 1997), the data collected from these multiple sources served as the basis for our own detailed case study on the emerging streaming media industry

and RealNetworks' role in it. To establish the validity of the reconstruction process, we compared our case history with the ones constructed by others (Freeze & Glassman, 2000; Reid, 1999). We used the case histories (our own and others) to identify the entrepreneurial actions taken by the firm and to create tables to organize this data chronologically.

These different sources enabled us to examine the data from multiple vantage points (Glaser & Strauss, 1967) and triangulate facts and inferences. For example, press releases provide detailed information on entrepreneurial actions, often including top managers' discussions of the expected consequences of these actions. However, press releases tend to emphasize the positive aspects of the various actions (Rindova & Kotha, 2001). So we supplemented them with media reports examining the same actions. In general, media reports provide more contextual and objective information about the nature of industry dynamics.

Approach to Analysis

For our analysis we used frameworks from the classic "Qualitative data analysis", by Miles & Huberman (1994) and Lee (1999). Our unit of analysis consisted of the decision-events that occurred in the creation of RealNetworks before it went public in September 1997. Our analysis proceeds in three stages. First, we perform a process trace of the decision-events as they occurred in the creation of RealNetworks, using the event listing method prescribed by Miles and Huberman (1994: 112). We began by listing the decision-events in the creation of RealNetworks in their chronological order and then examining whether they involved causal or effectual rationality using a qualitative pattern matching technique. At this stage, we investigate whether the overall process used in the creation of RealNetworks involves causation or effectuation and test Hypothesis 1. Second, we develop a case-ordered meta-matrix (Miles & Huberman, 1994:189) that allows us to relate the different types of uncertainty identified in the pre-analysis

stage with the results of Stage 1. This meta-matrix is used to logically connect the data with the three propositions of Hypothesis 2. Finally, we test Hypothesis 3 by changing the unit of analysis from decision-events to key strategies explicitly used by the firm in its attempt to establish itself as a leader in the Internet economy.

As is typical in qualitative research, we checked the validity of our insights in discussions with colleagues, and senior executives at RealNetworks. This iterative process, which included feedback from these discussions and an ongoing re-examination of the data, resulted in revisions and refinements of the analysis and results presented below.

RESULTS

Prior to our data analysis, we illustrate how Knightian uncertainty manifested itself in the different decision domains involved in the creation and evolution of RealNetworks – on its supply side, on its demand side, and in its macro environment.

Case Context: Knightian Uncertainties in the Internet Space

The Internet has been hailed not only as extremely new technology, but also as revolutionary, comparable in its potential impact on the economy to the invention of the Gutenberg press and the light bulb (Gates, 1995). All the same, for added precision and rigor, it is necessary for our analysis to identify the particular manifestations of Knightian uncertainty in the different decision domains during the early stages of the creation of RealNetworks.

In 1994, when the business world began recognizing the commercial potential of the Web, it had no voice. To its users, the medium was effectively mute due to several reasons. First, audio clips at that time had to be completely downloaded before they could be played or heard. A one-minute audio clip could take much more than five to 10 minutes to download onto a computer before a user could attempt to hear it. Therefore, unlike text and graphical images,

this up-front time investment made the use of audio untenable for most lay users. Using compression techniques and algorithms, RealNetworks pioneered the art of audio "streaming" aimed at overcoming the limitation of downloading audio files on the Internet. However, giving the mute Web voice, within the constraints of a for-profit entrepreneurial venture,[2] involved dealing with extraordinary uncertainties.

On the supply side, RealNetworks had to contend with not only a new and evolving technology, (i.e., audio streaming) but also with new and evolving hardware and infrastructure for the emerging medium (i.e., the internet) itself. For example, the ongoing struggle with bandwidth constraints that we face today were far worse when RealNetworks began operating on the Web. Also, in this evolution of multiple technologies, intertwined with the development of the Web, there were no clear technical standards or established protocols for audio streaming on which to build upon. In fact, the fight to become the de facto industry standard for audio streaming provided its own challenges exacerbating the Knightian uncertainties on the supply side. This meant that both the software products, and the technical specifications and protocols developed by RealNetworks had to continually respond to developments in infrastructure, demands by industry standard setting bodies, and competitive responses.

On the demand side, one of the main problems plaguing all Internet content providers was (and is) the search for revenue models that work. For instance, losses by major media corporations were so widespread during the early days of the Internet that, Don Logan, the CEO of Time Warner, declared publicly that his firm's Website, Pathfinder, "gave a new definition to the term black hole" (quoted in Kotha, 1998). The primary reason for lack of revenue models consists in the unwillingness of end-users to pay for the content they access on the Internet.

[2] I.e., without the aid of spontaneous and instantaneous miracles as posited by neoclassical economics, and outside the pondered leisure of government-funded institutions.

Unlike mass communications media such as radio and television, the interactive nature of the Internet (i.e., instead of the provider "pushing" content to passive users, the user actively "pulls" the content he or she wants to look at or listen to or download) made it difficult to create consistent and sustained sources of advertising revenue by distributing content. Further, the lack of established standards for audio streaming created low entry barriers for potential competitors of RealNetworks. A further complication existed in the form of the threat from software giant Microsoft wanting to enter and eventually dominate this critical Internet technology.

Regarding the macro-economic environment**,** the uncertainties on the demand and supply sides naturally caused large uncertainties in the financial markets of RealNetworks (i.e., for its investors). This was further complicated by the regulatory uncertainties that the entire Internet economy faced then (and continues to face now), including the enforcement of technical standards, and the ambiguities pertaining to privacy and tax laws.

In sum, we argue that Knight himself would surely be overwhelmed by the intensity of the intricate and multiple "Knightian" uncertainties that RealNetworks had to deal with during its early years. To unpack these multiple uncertainties and investigate *how* RealNetworks used the principles of effectuation to deal with them, we proceed now to describe the process trace in more detail in terms of the history of the firm.

Insert Table 3 about here

Hypotheses

Table 3 chronologically lists the key decision-events in the early history of RealNetworks, from early 1994 to September 1997, when the firm made its initial public offering (IPO). The earliest events before the official launch of its first product in April 1995 were garnered from a variety of histories of the company and several interviews with its founder, Rob

Glaser. Each of the decision-events between April 1995 and September 1997 are further chronicled in both the company's own press releases and in articles and commentaries from industry experts. Table 3 not only lists these decision events in detail, but relates them to the theory of effectuation in terms of its origin, principles, processes and overarching logic.

Hypothesis 1. Recall, this hypothesis posited that the firm creation process will begin with who the entrepreneur is, what he or she knows, and whom he or she knows, and not with a predetermined market. The first striking detail about the creation of RealNetworks is that its founder Rob Glaser did not initially set out to found a company in the audio streaming industry. In fact, early in 1994, Rob Glaser, the founder of what was eventually to become RealNetworks was toying with the idea of using interactive multimedia technology to create a "cable channel focused on politics and culture."

Robert Reid, who has chronicled the early growth of the Web and Rob Glaser's contributing role in the evolution of the Web, points out that:

> By summer he [Glaser] was trying to think of a way to bring his technical and political interest together. He figured that there had to be some leverage in such a combination, as it had long frustrated him that people who were "progressive in terms of world outlook" were "often downright Luddite when it came time to use new technology, particularly communication technology." That backwardness contrasted dismayingly with the facility that televangelists and their ilk had developed with new-ish mediums like cable TV. In response, Rob began toying with the idea of "using interactive multimedia technology to create a… think of it as a cable channel focused on politics and culture."
>
> The notion of interactive television (ITV) was by then [early 1994] all the rage. Many smug pundits were even viewing the PC as downright dowdy. For his part, Rob was at first agnostic about whether to use ITV or the PC as the medium for his half-formed vision. Then he encountered Mosaic—a 'total epiphany,' he remembers. He almost immediately concluded that 'interactive TV was going to be stillborn,' and that 'the whole mechanism that Mosaic had used to bootstrap itself, A, was a big deal in its own right, and B, once established, itself could be used as a bootstrapping mechanism for other stuff.' That other stuff, or rather some of it, turned out to be RealAudio.
>
> Once he had settled upon the Web as his distribution vehicle, a simple calculus of bandwidths and data rates drove Rob to focus on audio. The then standard 14.4 kbps modem was a claustrophobic tube for any kind of media. Given that video can be well over a hundred times the size of audio, Rob decided that dancing pixels would just have to wait. The notion of creating his own *progressive* content was soon lost in the excitement about creating the tolls, the *media type*, that would give the Web voice.

Edward Cone, of *Information Week*, confirms, "When Glaser left Microsoft in 1994, he planned to get involved with charitable and civic projects." And, Quittner of *Time* magazine writes:

> In high school, he and his pals jury-rigged a low powered radio station that skirted FCC rules and broadcast student news and sports programs to the classrooms. In 1983 Microsoft co-founder Paul Allen lured the Yale grad to Redmond, Washington, where Glaser quickly ascended to the company's topmost ranks, just under Bill Gates. … But after a decade, Glaser quit, a millionaire yearning for his activist past. "I wanted to put up my periscope and regain some perspective on the world," he says. You see, if Gates was Glaser's business role model, Cesar Chavez was his muse. A grape boycotter from way back, Glaser wrote a college-newspaper column called "What's Left" and has always been passionate about bottom-up grass-roots movements. Money, as far as Glaser is concerned, can be damned. "I'm not interested in the purely economic end of this anymore than Pavarotti is interested in getting paid to sing," he says. … He called his new company, appropriately enough, Progressive Networks.

In fact, the strongest evidence for Hypothesis 1 comes from the fact that the company was called Progressive Networks through all of its early history until just before its IPO in September 1997, when the name was changed to RealNetworks. At the very beginning (early 1994), there was no idea of a pre-determined market for real-time audio streaming on the Web, perhaps for the simple reason that such an industry did not exist. What existed was the fact of an entrepreneur with liberal leanings, and a love of radio since childhood, combined with substantial expertise in technology through his experience at Microsoft and a social network arising from that experience. In setting out to create a "progressive" channel on interactive cable, and as John Swenson of *Information Week* records, this entrepreneur volunteered for the Electronic Frontier Foundation, and encountered *Mosaic*, a contingency that inspired him to create the software that allowed streaming audio on the Web.

Further evidence in support of Hypothesis 1 is depicted in Table 4A, which tracks changes in target markets and pricing and new product introduction throughout the early history of RealNetworks. Target markets and prices for the software developed by RealNetworks changed and evolved at least 13 times over the 26-month period between April 1995 and June 1997. In most of these 13 new market segments, pricing was not known as the segment first opened up. As Table 4A makes explicit, very often, the firm either gave away the product or set tentative prices that changed rapidly as the firm actually tried to *sell* the product and partnered with an ever expanding network of strategic partners.

Insert Table 4A about here

Also sometimes, in cases where someone else conducted market research that suggested that the market for the product would not be large or that it might be non-existent, RealNetworks pressed on in an "evangelizing" fashion rather than trying to predict and respond to a pre-existent market. For example, Kim Nash of *Computer World* reports,

> But Progressive will have to overcome information systems (IS) managers' doubts about whether audio is too bandwidth-hungry to work well and whether there is even a need to add voice to internal applications. … Some IS managers said the flash of multimedia just isn't necessary in telephone directories or human resources information applications for which most intranets are used today. But progressive disagrees. "If there were a simple way to add audio to programs, IS would find new uses for it," said Rob Glaser, president and CEO of the 2-year-od company. For example, users could put executive speeches online or add audio to computer-based training courses, he said.[3]

In sum, while the evidence for quickly bringing new products to new target segments abounds in all historical and interview accounts of the creation of RealNetworks, there is virtually no evidence that the firm did or even *could* calculate any realistic estimates of the size of its markets or expected return. Therefore, we provisionally conclude that RealNetworks made its choices of potential markets based on a combination of affordable loss (as established above), and strategic partnerships and unanticipated contingencies (to be established in greater detail in the section that follows), and that Hypothesis 1 is supported.

Hypothesis 2. This hypothesis consists of three parts each corresponding to the three key principles of effectuation we discussed: (1) calculations of affordable loss, rather than expected return; (2) the use of strategic partnerships, rather than competitive analysis; and (3) the leveraging of contingencies, rather than avoiding them. To test these sub-hypotheses, we draw upon the evidence assembled in Table 3 in concert with Table 4A, 4B, and 4C respectively; and then integrate the entire analysis, including the multiple Knightian uncertainties and the three

[3] In reality this is exactly how the industry for video streaming has unfolded. Most, if not all, of the conference calls (discussions between financial analysts and a company's top management) are now available in streaming format on the Internet.

principles of effectuation into a case-ordered meta-matrix in Table 5. This table explicates concisely and convincingly how exactly RealNetworks employed the three principles of effectuation to overcome multiple Knightian uncertainties in the different domains of its environment.

Insert Tables 4B, 4C and 5 about here

Hypothesis 2a: Affordable loss, rather than expected return. When Rob Glaser first decided to develop the compression software that would allow real-time streaming audio on the Internet, he did not set out to conduct detailed market research and develop precise financial projections in order to raise money and capture the market. Instead, as Robert Reid and other observers of the company have noted, he set out to build the product with his own money supplemented by funds from close friends such as Mitch Kapor.[4] As John Swenson notes, "No hat-in-hand entrepreneur, Glaser funded his startup with some of that Microsoft stock that he had accumulated over a decade. 'I used my own grubstake to get the ball rolling,' he says, 'We didn't have to waste a lot of time.'" As noted earlier, beginning with a relatively vague but personally meaningful idea for starting a "cable channel focused on politics and culture", and responding to an unexpected but "epiphanic" contingency called Mosaic, he proceeded to *act* – to create and bring a product to market, however much tinny its sound or disdainful the criticism of the current internet elite for his vision for giving voice to the Web.

Hypothesis 2b: Strategic partnerships, rather than competitive analyses. But just developing the product and bringing it to market was far from inadequate to manage the Knightian uncertainties that RealNetworks was faced with. In bringing the product to market, Glaser and his associates wove together numerous strategic partnerships that together resulted in

[4] Mr. Kapor was the founder of Lotus Corporation, the company that is often credited with providing the "killer application" (i.e., the Lotus Spreadsheet) for the initial launch and diffusion of the IBM PC.

what appeared to be markets pulled out of a hat, as it were. Table 4A lists at least thirteen such markets that were created over a 26 month period. In each case, a network of strategic partnerships managed to leverage a series of contingencies to create several unanticipated markets for the products of RealNetworks. Richard Brandt quotes Rob Glaser in *Upside* magazine as follows:

> When we launched, we didn't just launch a piece of software and say, "Try it." We launched with news content from National Public Radio, from ABC. We'd lined up about 20 to 30 indigenous Internet people, like HotWired and Adam Curry, the [former] MTV video jockey, [who had] one of the first audio Web sites.

Confirms Reid (1997, p79),

> RealAudio debuted on the Web on April 10, 1995, along with content from ABC News, National Public Radio (NPR), and others. Tiny Progressive was soon covered by such publications as The New York Times, The Wall Street Journal, and The Economist. USA Today characterized RealAudio as 'The technology of the '20s meeting the technology of the '90s,' while Time [Magazine] meanwhile assured the image-conscious that 'Glaser's system is not just for geeks.'

And the saga of RealNetworks' strategic partnerships continued throughout its early history as chronicled in Table 4B. Over a period of 29 months, the company created at least 150 strategic partnerships, 55 of which are named in Table 4B. In the following paragraphs, we examine just a fraction of its partnerships to understand how they helped create and secure new markets for the company's products, while making its brand almost synonymous with audio-streaming on the Web.

Within a month after RealAudio 1.0 was launched in April 1995, Netscape, the world's largest browser-software firm, began shipping RealAudio as part of its Navigator browser software. By August of that year, RealNetworks had sold its server software products to several large Internet media companies including Starwave, Ziff-Davis, and ABC News, firms that were in the content generation business.

The firm also partnered with software companies that dominated the operating systems and software applications market place. For example, it worked with Microsoft to ensure the

RealPlayer and RealSystem products worked in Windows 95 and Windows NT environments. It also partnered with Sun Microsystems, the makers of the Solaris Operating Systems to ensure that RealNetworks' products would operate smoothly in the Unix environment. The firm also made its products compatible with machines that use the Macintosh Operating System. Additionally, RealNetworks created agreements with Macromedia Inc., the largest provider of animation-editing software, to transmit animated material over the Internet.

The firm also partnered with technology companies to create combined services in form distribution options for content on the Internet. In August of 1997, for example, RealNetworks signed a joint venture agreement with MCI and launched the Real Broadcast Network. This pilot service, created by combining the RealSystem technology with MCI's world-wide Internet network infrastructure, offered broadcasting services for content developers to deliver tens of thousands of video streams simultaneous on the Internet. MCI, which owned a significant portion of the Internet infrastructure (or backbone), had upgraded its infrastructure to facilitate rapid streaming. This was done by strategically placing RealNetworks splitter and multicast technology throughout its network. Such devices eliminated bottlenecks by allowing computer users to access a video/audio feed from the closest of MCI's nine US locations. RealNetworks and MCI targeted media companies and Fortune 1000 companies that might use this service for internal employee training or to post new product announcements on the Web. ABC News' on-line service, for example, used the service to broadcast audio and video clips accompanying a text story of the 1997 UPS strike. Other customers included Atlantic Records, ESPN, and Home & Garden Television.

Each strategic partnership helped RealNetworks not only open up new markets for its products, but helped *create* entire new markets for the industry as a whole. Often, each new

market being created or conquered by RealNetworks also brought it new competitors and sometimes brought imitators into being. As Table 4C shows, several of the competitors for RealNetworks did not even exist until it entered into or created new market segments for its products. Interestingly enough, sometimes, potential competitors became the primary strategic partners in the early stages, and then later separated themselves from the firm's strategic partnership network and turned into major competitors. Microsoft and Macromedia are two examples of such a co-operative/competitive dance in the creation of RealNetworks.

To sum up our analysis of the evidence assembled for Hypothesis 2b, the overarching emphasis that RealNetworks placed on strategic partnerships over mere reliance on competitive analysis, paid off handsomely in the rapid growth of its user base and the consequent brand ubiquity of its product offerings. Several industry analysts and technical experts have studied this phenomenon and commented on the fact that although RealNetworks did not always have the best *technical* product, the sheer strength and scope of its partners created insurmountable entry barriers for current and potential competitors and also made competitors' products less attractive for the end user. For example, in a critical evaluation of five companies in the real-time streaming industry in April 1996, Peter Jasco of *Information Today* observed:

> In mid-March, RealAudio 2.0 was by far the most popular streamer and server, and that's what defined the choice of the end user. Even if the compression factor of RealAudio is not stellar, it has such giant broadcasting companies as ABC, CBC, NPR, and PBS behind it, not to mention many smaller ones such as Internet News Radio and Internet Radio Hawaii. Music stores and music labels also prefer RealAudio, which is used by World Wide Music, 1-800-Music-Now, Polygram Records, and Warner Brothers.

Just months later in September of 1996, the firm released yet another version, this time RealAudio 3.0. Shortly thereafter Prodigy, a leading Online Service Provider, began bundling the firm's player software with its custom browser. Although there were a handful of other firms providing audio-streaming solutions, none matched the rapid growth of RealNetworks.

Hypothesis 2c: Leveraging contingencies, rather than avoiding them. As Table 3 demonstrates, the story of the creation of RealNetworks is a story of quick and continual product introductions, incessant ever-expanding strategic partnerships, and a multitude of contingencies that turned out to be growth opportunities. While the very idea for streaming audio emerged out of an epiphanic contingency when the founder encountered Mosaic, the company then grew through a variety of contingent partnerships, some intended and others unintended. The most striking and far-reaching of these contingencies consists in the story of how RealNetworks entered the video streaming market. According to a report in *Wired* magazine:

> In December 1995, while attempting to vacation in Hawaii, Glaser got some email from a two-person San Francisco company, FreeVu, which had an Internet videoconferencing tool under development. Glaser took a look, was impressed, and persuaded FreeVu's principals to sign on as Progressive employees. RealVideo's development effort had begun.

In February of 1997, the firm released a product that combined video and audio streaming, RealPlayer 4.0. At this time however, unlike when the audio-only player was released, there were several video-streaming providers, Xing Technologies, VDOnet, Vosaic and Vxtreme, who already marketed products on the Web. Recognizing this, Rob Glaser signed an exclusive licensing agreement with Microsoft to bundle RealPlayer with Internet Explorer. With such an agreement, the firm had little difficulty in achieving a dominant position in video streaming on the Internet. Once again the principle of strategic partnerships helped shape and control an unpredictable and evolving market.

Most importantly, as noted earlier, RealNetworks managed to compile an impressive list of companies that used its server software to transmit multimedia content over the Internet. This list included all three major US television networks (NBC, ABC and CBS), two major long-distance telephone carriers, the United States Senate, and many of the biggest companies in the music industry, including SONY. In just four years since founding, RealNetworks produced

over eight product varieties and grew to over 350 employees. In interviews on several occasions, Rob Glaser consciously or unconsciously alludes to the contingent nature of the creation of RealNetworks. Mark Fefer reports in *Fortune* magazine in July 1996, for example,

> Whether people will pay to hear Peter Jennings on demand remains to be seen. Glaser is optimistic: "We don't know what offerings are going to be most exciting or important," he says, "but the Net rewards people who just sort of do stuff."

Contingencies can be both good and bad. When Microsoft decided it wanted a bigger bite of the streaming media market all to itself, it turned from being a strategic partner into becoming a fierce competitor to RealNetworks. All the same, an entrepreneurial company such as RealNetworks needs to open itself up to contingencies and try to leverage surprises as they come, and not spend all its energies in trying to avoid them. In most cases, such a company has no choice but to be open to surprises, but in other cases, the contingencies actually work in its favor especially when they are leveraged into opportunities. In explaining the astonishing growth of his company and its entry into the video streaming business to Richard Brandt of *Upside* in May 1997, Rob Glaser states,

> All this sounds great in hindsight. I voted with my feet. I put a substantial amount of money into this. I don't think this is revisionism. The more I got into it, the greater confidence I had that this was not a [passing fad]. … Once we demonstrated Internet audio, others started trying to do the same thing with video. But nobody prior to us, prior to RealVideo, created anything satisfactory. You have smart, energetic people looking at it. So it's not shooting fish in a barrel, that's for sure. But last time we had an installed base of zero users, we had no relationship to media companies, we had no visibility or credibility as a company. Our level of financial resources was large enough to keep going, but nowhere near as large as it is today. … We've worked on RealVideo for 15 to 18 months, and it leveraged off all our transmission technology. We aren't the first to do video on the Internet. We are the first to bring critical mass to the experience.

Summarized and integrated in the case-ordered meta-matrix in Table 5, the above analyses of the three sub-propositions of Hypothesis 2 show that when a company such as RealNetworks emerges out of its embryonic phase into an environment characterized by Knightian uncertainty, it usually does so feet first, with little clarity about the comforting old standby's of causal reasoning such as expected return, detailed competitive analysis and calculated avoidance of contingencies. Instead, it has to grow its senses about such parameters

by pushing its way quickly into new markets and relying on a variety of strategic partners to help leverage unanticipated contingencies into palpable opportunities for future revenues and profits. Thus, Hypotheses 2a, 2b and 2c are supported.

Insert Figure 2 about here

Hypothesis 3: *The logic of control rather than prediction.* The three principles of effectuation examined above together constitute the logic of control that forms the cornerstone of the creation of firms in the face of Knightian uncertainty. Hypothesis 3 explicates this logic further as follows: The strategies implemented by the firm will seek to control and create the market rather than to predict and follow it. Through the three years of its birth and early growth, before its IPO, every tactic that RealNetworks used can be grouped into meaningful clusters. Ordering the decision events into meaningful sub-clusters and then testing them through discussions with several participants in the development of our case study about the firm, we developed three predominant clusters of the firm's key strategies. The key strategies, presented in Figure 2, consist of: (1) influencing industry standards; (2) alliances; and, (3) continual innovation. We now examine each with a view to demonstrating the logic of control rather than prediction in the creation and growth of RealNetworks.

Influencing industry standards. Looking at the actual decision-events in the case, we can see that getting RealAudio 1.0 to market within a year using his own funds, Rob Glaser effectively parried problems of evolving standards in the industry. The fact that RealNetworks was the first to launch its technology was a very important factor in it ultimately becoming the de facto industry standard. Being a first mover in this domain was critical because such industries are subject to the notion of increasing returns to scale (Shapiro and Varian, 1998; Kotha, 1998). As the firm's base of installed RealPlayer products increased, it enabled content producers to

offer content that could be listened-to/viewed using this software. This growing content then increased the value of the RealPlayer software to consumers, which then led to greater demand for the RealPlayer software, which in turn translated into a greater installed base. In other words, in an increasing-returns-to-scale world, success begets success (Hill, 1997). Further, once users download RealNetworks' technology and install it on their machines, many users will avoid using another product because the use of a new technology involves learning the nuances of that particular technology. Likewise, content producers will produce content for the technology that is most widely distributed and available to the end user. For that reason, content producers get "locked" into using RealNetworks' server technology to produce content and make it available on the Internet.

An 80% market share made the products of RealNetworks the de facto industry standard for stream content on the Internet, a reality that could not have been achieved if Rob Glaser had spent the first year analyzing the market or carefully developing the perfect technology that would overcome possible competitive responses. Instead, by bringing the product to market with the least possible investment created a "proof of concept" that could then be leveraged to bring in outside investors, even though the revenue model had not yet crystallized and continued to evolve over the next few years.

Besides garnering market share and creating investor credibility through the affordable loss principle, on the supply side, RealNetworks' efforts also focused explicitly on shaping industry standards and protocols for streaming technology through strategic partnerships and pre-commitments from key players. RealNetworks joined other important industry players (e.g., Microsoft and Sun Microsystems, in particular) in their efforts to set protocol, transmission and compression standards. As set out in the continuation of Table 4C, RealNetworks participated in

at least four major standards bodies to shape and control industry standards. For example, RealNetworks and Microsoft took special efforts to define the industry standards for streaming products. Their goal was to ensure that any server software could send streams (audio and video) to any player. Emphasizing the need for common standards, Microsoft's Windows Media Player was able to play streams from RealNetworks' server software. Also, NetShow, a Microsoft server product, played video streaming from RealNetworks' server products. Similarly, RealPlayers could play video streaming from Microsoft's NetShow server. Rich Tong, a Microsoft vice president, noted at the time: "The user only wants it to work. ... So it is good business to work with RealNetworks to set standards for compatibility and expand the market for all of us."

Alliances. Effectuation is based on the logic of control and explicitly eschews the need for prediction. The essence of effectual reasoning consists more in attempting to shape and create the future environment than to try to predict the possible states. So effectuation combats a variety of very complex and plural uncertainties through partnerships and pre-commitments from key stakeholders rather than through detailed competitive analyses or investments in diversified portfolios of predictions about the future state of the environment.

RealNetworks partnered with an astonishingly large number of stakeholders ranging from Microsoft and Netscape through TV networks such as ABC and NPR to entrepreneurial startups such as VXtreme and FreeVu. Earlier, we noted that being the first into the market with a streaming technology, was critical to RealNetworks' success in establishing itself. Being the first mover, although important, does not make a technology the de facto industry standard (Shapiro and Varian, 1998). Multiple factors must coalesce simultaneously for a technology to be an industry standard. First, the firm with a particular technology must work with and shape

the industry's standards and protocols so that other firms will accept its version of the technology. Second, different types of strategic alliances and partnerships are necessary to make a particular technology successful. For instance, there are distribution alliances, content alliances, and compatibility alliances. In general, the greater the number of alliances a firm enters into, the higher the probability that its technology will become widely distributed (Garud et al., 1998). Alliances and agreements ensure a wide initial distribution of the firm's technology, which then can help to jump-start an increasing returns mechanism. Also as the technology gets widely distributed it becomes accepted as the de facto industry standard (Baum, Korn & Kotha, 1995).

Continual Innovation. Also, the status of a technology as the de facto industry standard at any point in time does not ensure that this particular technology will continue to be the industry standard in the future (Hill, 1997). The firm's technology must be the subject of continuous innovation (Garud et al., 1998). This is because competitors are likely to imitate and challenge the leader's product capabilities. In other words, in technology based industries competitive advantage tends to be transient and, thus without innovation the leading firm is unlikely to maintain its leadership position. Hence, the firm devoted a substantial portion of its resources to developing new products and product features, expanding and improving its fundamental streaming technology, and strengthening its technological expertise. For example, during the fiscal year ended December 31, 1996, and the six months ended June 30, 1997, the firm spent 34% and 41% of its total net revenues on research and development activities. As of August 1997, the firm had 90 employees, or 32% of its workforce, engaged in research and development activities.

Part of RealNetworks' R&D strategy was to hire the brightest, most experienced developers and executives in the world. According to Rob Glaser: "In an industry where intellectual capital is the primary asset of the firm, the people you hire can make or break the firm. Developers must be constantly nurtured and trained in order to turn out new technology at the speed of light." Glaser combined this continual innovation through hiring the best wherever and whenever he could find them with using every contingency that he could to highlight the continual innovations of the firm. As early as September 1995, for example, RealNetworks' first live broadcast suite was demonstrated when a Seattle Mariner-New York Yankees game was served up on ESPN's web site, ESPNET SportsZone. This led to ABC using the same technology for its live news broadcast, devoting it especially to the O. J. Simpson trial, another contingency that built the RealNetworks brand and helped make it ubiquitous.

To sum up the arguments embodied in the three-pronged strategy presented in Figure 2 and explained in detail above, we need to examine how the logic of control acts upon Knightian uncertainty.[5] First, it makes prediction unnecessary and irrelevant. In the case of RealNetworks, no one, including the founders and partners of the firm could have predicted either the development of new technologies related to the market or the competing firms that would eventually constitute the structure of that market. But, by releasing intermittent versions into the end-users hands, not only could the customers become partners in continual innovation, but they became inextricably intertwined with the creation of the market itself. In other words, by not trying to predict what the market *would* be, RealNetworks ended up creating various components of the market as it *could* be. Second, in a paradoxical fashion, the logic of control destroys Knightian uncertainty by making the future almost perfectly predictable. In other words, by aligning itself with a variety of strategic partners, many of whom turned out eventually to be

customers and even competitors, RealNetworks could in one sense predict their behavior perfectly, because it had helped *negotiate* that behavior into existence. Creating official industry standards is one example of such negotiated behavior.

Third and finally, the logic of control makes uncertainty a friend by leveraging surprises that come its way. In all its three strategic poles, RealNetworks managed to seize contingencies to create and penetrate several new markets and also to grow rapidly from nothing in 1994 to $1.7 M in revenues and $7.5 M in assets in 1995, and $ 36.3 M in revenues and $119.4 M in assets when it went public in 1997. In other words, Hypothesis 3 is supported.

DISCUSSION

The goal of this study was to examine whether, and to what extent, entrepreneurs who build companies in the real world use effectuation. Using an in-depth case study approach, we sought to understand the use of effectual rationality in the decision-events that led to the creation of the Internet-company RealNetworks. We have highlighted and discussed how this firm dealt with a host of uncertainties, many of which fall under the rubric of Knightian uncertainty. As noted in the introduction, our analysis of the RealNetworks case indicates that the theory of effectuation integrates the variety of heuristics used by entrepreneurs as identified by earlier studies (e.g., Busenitz & Barney, 1997; Baron, 2000) under the umbrella of a common logic—the logic of effectual control.

The logic of effectuation – *to the extent that we can control the future, we do not need to predict it* -- is particularly useful in areas where human action (locally or in the aggregate) is the predominant factor shaping the future. For example, instead of defining a market as the universe of all possible customers as Kotler (1991: 63) defines it, an effectuator would define *his or her* market as a community of people willing and able to commit enough resources and talents to

[5] We would like to thank Nick Dew in helping us clearly see and articulate these three uses of the logic of control.

sustain the particular enterprise. In the former case, the market is assumed to exist *independent* of the firm or entrepreneur, and the task of the entrepreneur is to corner as much of this market as possible. In the latter case, however, the founder, along with others, *creates* the market by bringing together enough stakeholders who "buy into" the idea to sustain the enterprise. Since the structure of what exactly is the enterprise is left open and dependent upon the particular commitments made by the stakeholders, the need for prediction is greatly reduced, if not completely obliterated. In other words, the particular firm created becomes *the residual* of a process of constructing a network of partnerships and pre-commitments, using contingencies that get thrown across the development path, and the market itself is an aggregated taxonomy of such sustainable sets of partnerships and commitments (Sarasvathy, 2001a).

As for implications of the current study for creation of firms and markets in the new economy, we examine the three-fold strategy used by RealNetworks as graphically represented in Figure 1. The three key aspects of the entrepreneurial strategy depicted here operationalize the three principles of effectuation, and are applicable to other startups in the new economy: (1) The formation and maintenance of multiple alliances; (2) The persistent efforts to mold industry standards and align them with one's own products; and, (3) Continual innovation bringing new products and new versions of existing products as quickly to market as possible. Not only do these strategies appear in almost all the anecdotal evidence regarding new economy startups (Reid, 1999), but they are also theoretically meaningful in terms of the three principles of effectuation applied to the multiple Knightian uncertainties faced by new firms in the new economy.

In this case study, meticulously careful in its detail and rigorously multiple in its data sources and analyses, we have established not only that RealNetworks used effectuation in its

own creation, but have shown *how* it used the specific principles and overall logic of effectuation. Furthermore, the results are made more compelling by the fact that the analysis builds upon earlier studies involving field experiments and historical, as well as anecdotal evidence (Sarasvathy, 2001a). Sarasvathy (2001b) had demonstrated that expert entrepreneurs overwhelmingly prefer effectual reasoning to causal approaches in creating new firms and markets. Therefore, this study not only stands on its own as test of the theory of effectuation, it also serves as a further test of reliability for earlier studies. By demonstrating the use of effectuation in a real world case study, this paper serves to multiply the methods used and cumulate the evidence for the theory.

But an important word of caution is needed while interpreting the results of the analyses presented in this paper – and that concerns the implications for success/failure of these new ventures. Even with the combined reliability of the multiple studies in the research program involving the theory of effectuation, one cannot conclude any causal connections between the use of effectual reasoning and success in new venture creation. Just as causal reasoning can be used in more effective and less effective ways to create or destroy value for firms and economies, effectuation too can be used in more or less successful ways. The evidence seems to suggest only that effectuation processes are in actual fact used more by entrepreneurs faced with complex and plural Knightian uncertainties. Centuries of development have gone into honing techniques of statistical analysis and estimation, the methods used to deal with Knight's first two urns. Similarly, continuing exploration and testing of techniques of effectuation will be required before we can begin making normative prescriptions for dealing with his third urn in entrepreneurial decision making. At the present time, the primary contribution of this paper is to

add to the mounting evidence that effectual reasoning contains a useful bag of tools for the potential entrepreneur and a testable theory for entrepreneurship scholars to build upon.

Conclusion

In his review of social thought and its refiguration in the social sciences, the reputed anthropologist and social scientist *par excellence,* Clifford Geertz recalls how crafts and industry historically provided the basis for what we now recognize as the ”hard” sciences. He writes: *Science owes more to the steam engine than the steam engine owes to science; without the dyer's art there would be no chemistry; metallurgy is mining theorized* (Geertz, 1983: 22). It is in this sense that effectuation is entrepreneurship theorized. We have shown in the above case study that effectuation closely traces actual processes and decisions acted out by real entrepreneurs. We have further shown that this reality inverts key principles of our existing theories. The challenge then for scholars of entrepreneurship is to push the theory further to create a viable science of entrepreneurship. We believe that in meeting this challenge we not only need to rethink our strategies for research, but also that we must re-examine the very questions we are asking and re-frame the way we are currently formulating the central problems in entrepreneurship and management.

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TABLE 1
Three types of uncertainty and how to deal with them

Type of Uncertainty	Risk	Uncertainty	Knightian Uncertainty
The distribution of the future	The future has a known distribution	The future has an unknown distribution	The future has no distribution – it is unknowable
Type of probability	A priori	Statistical	Unclassifiable instances
Example	Urn contains 5 green balls and five red balls. Drawing a red ball wins $50	Urn contains unknown number of balls. Drawing a red ball wins $50	Urn may or may not contain any balls – even the existence of the urn may be in doubt
Methods to deal with uncertainty	Analysis	Estimation	Effectuation

TABLE 2
Means available for effectuation at three levels

Level of analysis	Means Available		
Individual	Who I am	What I know	Whom I know
Firm	Physical resources	Human resources	Organizational resources
Economy	Demographics	Technology regimes	Institutions

TABLE 3
Event Listing and Process Trace
of effectuation principles used in the history of RealNetworks

Date	Decision/Event	Process Trace of Effectuation Principles Used
Early 1994	Rob gets the idea for using interactive multimedia to create a cable channel for politics and culture	Starting with means consisting of (1) who he is;
Leading up to April	Encounters Mosaic and has an epiphany about bootstrap mechanisms	(2) what he knows; and,
	Calls a compression expert from his Microsoft days and realizes that video would have to wait and decides to focus on giving the Web voice	(3) whom he knows
April 1994	Founds Progressive Networks with $1 M of his own money	Affordable loss, not expected return
April 1994 to April 1995	Funding from friends and development of RealAudio	Whom he knows to increase affordable loss
April 1995	Launch of RealAudio garners media attention	Affordable loss to market and garnering feedback
	Launch of RealAudio: Prices not locked down	Affordable loss to market and garnering feedback
	Launch of RealAudio: Programming includes ABC News, Voice of america, National Public Radio, Seattle Mariners baseball games and, Radio Yesteryear	Strategic partnerships
May 1995	Netscape starts shipping RealAudio as part of its browser software	Strategic partnerships
August 1995	Customers – Starwave, Ziff Davis, ABC News	Expanding networks of strategic partnerships
September 1995	Seattle Mariners – New York Yankees game served up on ESPN using RealAudio	Leveraging contingencies to create a brand
September 1995	ABC uses RealAudio to broadcast the OJ Simpson trial	Leveraging contingencies to begin making the brand ubiquitous
October 1995	RealAudio 2.0	Iterative loop of affordable loss and customer feedback
December 1995	Glaser receives email from FreeVu and induces the founders to join him – development of video streaming product begins	Leveraging contingencies – and thereby acquiring knowledge resources and more partnerships
January 1996	VRML and Javascript developed – Real Audio now becomes part of Web-authoring software for multimedia presentations	Leveraging contingencies – new market for both audio and video streaming emerges
February 1996	Progressive Networks pledges support for Netscape's LiveMedia framework – assuring compatibility of streaming audio and video with browser software	Strategic partnerships to control rather than predict the future
April 1996	RealAudio 2.0 introduced and Access Graphics selected as VAR channel	Expanding strategic partnerships
April 1996	RealAudio 2.0 wins Internet World Magazine's top award	Leveraging contingencies to make the brand ubiquitous and attract more strategic partnerships
April 1996	National Geographic goes online on Compuserve's network with RealAudio technology	More strategic partnerships
August 1996	Progressive Networks and House of Blues introduce LiveConcerts.com	Strategic partnerships to make brand ubiquitous
September 1996	RealAudio goes retail – shrink-wrapped to store shelves	Strategic partnership with Selective

		Record – still chasing ubiquity as market begins to coalesce and mature
September 1996	RealAudio 3.0 launched and Prodigy starts bundling it with its custom browser	Strategic partnerships
October 1996	Progressive Networks and Netscape put together a coalition of 40 companies in endorsing a multimedia standard called RTSP (Real Time Streaming Protocol)	Logic of control, rather than prediction
October 1996	RealMedia – multimedia architecture with converters from other platforms	Logic of control, rather than prediction
February 1997	RealPlayer 4.0 – Audio and video combined	Iterative loop of affordable loss and customer feedback
February 1997	RealVideo 1.0 – partnerships with and endorsements from 50 entertainment, content, and computer companies	Strategic partnerships
July 1997	Microsoft acquires 10% non-voting stake	Strategic partnerships
August 1997	Joint venture with MCI to launch Real Broadcast Network	Strategic partnerships
September 1997	Change of name to RealNetworks and IPO	

TABLE 4A
Process Trace of target market changes in the creation of RealNetworks

Date	Product	Target Market	Pricing	Source
April 1995	Real Audio 1.0	Audio-on-demand for the internet	$5 per month subscriptions As-supported models	Mediaweek, April 10, 1995
May 1995	Real Audio 1.0	Real time radio		Time, May 1, 1995
Jun 1995	Real Audio Server	Companies that create RealAudio soundtracks to promote their wares on the Web	Up to $5,000 per software package	The Economist, Jun 24, 1995
Sep 1995		Possible new market – Desktop audio for classrooms and presentations		Communications of the ACM, Oct 1995
Oct 1995	Real Audio Server	Companies that create RealAudio soundtracks to promote their wares on the Web	$1,500 per package	CommunicationsWeek, Oct 23, 1995
	Real Audio Personal Server	Individuals that create RealAudio soundtracks to promote their wares on the Web	$99 per package	CommunicationsWeek, Oct 23, 1995
Mar 1996	Real Audio Server 2.0	Event promotion for companies – corporate speeches, conferences, marketing events	$495 for five streams or channels and $3,995 for an unlimited number on a T-1 line	American Demographics, Mar 1996 CommunicationsWeek, Apr 3, 1996
May 1996	RealAudio Player 2.0 RealAudio Server 2.0	For Microsoft Windows 95 Companies and institutions	$29 Two –tier pricing changes: $495 for five streams or channels and $1,895 for a 2CI stream, and $8,495 for 100 channels on a T-1 line	Information Today, May 1996
May 1996	Timecase	A sort of TV guide for audio content – lets users preselect news, info and radio broadcasts they would like to download	Not priced yet	Business Wek, May 20, 1996
Aug 1996	LiveConcerts.com	Internet music channel – weekly concerts on line		Broadcasting & Cable, Aug 19, 1996
Sep 1996	RealAudio Player Plus	Retail product – shrink-wrapped for store shelves	$30	CommunicationsWeek, Sep 16, 1996
Oct 1996	RealMedia Architecure	Toolkit for software developers – converters from other platforms and a variety of plug-ins included		Computer Reseller News, Oct 28, 1996
Feb 1997	RealVideo 1.0	Content providers, as well as end-viewers	Server software range $295 to $4,995; client software free	InfoWorld, Feb 17, 1997
Jun 1997	RealPlayer 4.0	Corporate Training – partnerships with WingsNet and ViaGrafix		InfoWorld, Jun23, 1997

TABLE 4B
Process Trace of competitor-matrix changes in the creation of RealNetworks

Date	Target Market	Competitor	Source
May 1995	Real time radio on the Web	Radionet.com – radio on the Web with interactive call ins	Information today, May 1995
Sep 1995	Live RealAudio – broadcasting live events over the Web / Compression/decompression software	The DSP Group Inc. – TrueSpeech Audio	CommunicationsWeek, Sep 11, 1995
Jan 1996	Video streaming	Xing Technology White Pine Software	The Economist, Jan 20, 1996
Mar 1996	Real time audio – market begins to come of age	Xing Technology's Streamworks DSP Group's TrueSpeech Vocaltec Internet Wave Voxware's Toolvox	Information Today, Mar 1996
Mar/Apr 1996	Web-to-phone audio streaming and vice versa	IDT –combines callback technology with Internate connections, enabling talking via computer to an actual telephone	Franchising World, Mar/Apr 1996
	Str partners turn competitors	Macromedia and Microsoft	
Feb 1997	RealVideo 1.0	Netscape and Microsoft Vivo software; Vosaic Corp; and Vxtreme Inc.	CommunicationsWeek Feb 17, 1997

TABLE 4C
Chronological list of Strategic Alliances

#	Date	Alliance	Source
1	April 1995	ABC News	Mediaweek
2		Voice of America	
3		National Public Radio	
4		Seattle mariners baseball game	
5		Radio Yesteryear vintage radio shows	
6		Ex-MTV VJ Adam Curry's Metaverse	
7		Microsoft co-founder Paul Allen's Starwave	
8	June 1995	Microsoft	Computerworld
9		Netscape	
10	September 1995	On Ramp	CommunicationsWeek
11	November 1995	E&P – Editor & Publisher Co.	Editor & Publisher
12	November 1995	Sony	Informationweek
13	December 1995	CheckPoint Software Technologies Ltd.	Computer Reseller News
14	January 1996	NetManage Inc.	CommunicationsWeek
15	February 1996	AT&T	Computerworld
16	March 1996	Macromedia	InfoWorld
17	April 1996	Access Graphics	Computer Reseller News
18	April 1996	National Geographic	CommunicationsWeek
19	May 1996	Apple	Macworld
20	May 1996	Marshall Industries	Informationweek
21	August 1996	House of Blues	Broadcasting & Cable
22	September 1996	CBS Radio	Broadcasting & Cable
23		NBC	
24		CBC – Canadian Broadcasting Corp.	
25	October 1996	Prodigy Internet	Broadcasting & Cable
26	November 1996	Dow Jones & Co.	Editor & Publisher
27	February 1997	Warner Brothers	Broadcasting & Cable
28	February 1997	Discovery	Broadcasting & Cable
29		MSNBC	
30		Fox News	
31		Time Warner	
32	February 1997	C-Span	CommunicationsWeek
33		Ephyx Technologies, Herzliya, israel	
34		In-synch Corp., Bethesda, MD	
35		Terran Interactive, San Jose, CA	
36		Winstruct, Kirkland, WA	
37	February 1997	BBC	Broadcasting & Cable
38		Children's Television Network	
39	March 1997	Ingram Micro Inc	Computer Reseller News
40	May 1997	Smith Barney	Mediaweek
41		Eddie Bauer	
42		Volvo	
43	May 1997	Starlight Networks	InfoWorld
44	May 1997	Silicon Graphics	Informationweek
45	May 1997	The Disney Co.	Broadcasting & Cable
46	June 1997	A 100 diverse companies….	Computer Reseller News
47	June 1997	Dell Computer Corp.	Advertising Age
48		The Gap	

49		GM's Buick division	
50		Sprint Corp	
51	June 1997	The Weather Channel	InfoWorld
52		Comedy Central	
53		Dr. Science	
54	August 1997	@Home Network	Telephony
55	August 1997	MCI	Network World

TABLE 4C CONTINUED
Chronological list of Standards Alliances

#	Date	Alliance	Source
1	July 1995	Information Highway Patrol Empowerment Group "Surfwatch" -- With Netscape and Microsoft	Computer Reseller News
2	February 1996	The LiveMedia framework – RTP (Real-time Transport Protocol – with Adobe, DEC, Macromedia, NetSpeak, OnLIve, Precept, SGI, VDONet, VocalTec and Xing Technologies	InfoWorld
3	August 1996	Access Graphics' WebLink Program – consortium of vendors, VARs, systems integrators and consultants	Computer Reseller News
4	October 1996	Real Time Streaming Protocol (RTSP) – with Aple, DEC, HP, IBM, Sun, Macromedia and SGI	Broadcasting & Cable

TABLE 5: CASE-ORDERED META-MATRIX:
How RealNetworks used effectuation principles to combat Knightian uncertainties

		Using the logic of control through:		
	Sources of uncertainty	**Affordable loss**	**Strategic Partnerships**	**Contingencies**
SUPPLY SIDE	Technology Uncertainty • Evolving standards • Bandwidth constraints • Hardware and infra-structure still evolving	80% market share makes it the de facto standard – this market share garnered through iterative development and introduction of continual upgrades in record time to market.	Several partnerships with developers of complementary products and even with infrastructure developers such as MCI.	RN continually pushes the standards committees to accept the technologies it has developed.
	Product Uncertainty • Product is changing • Functionality is changing	Continual innovation through tight user feedback loops and minimal time to market.	Making RN technology flexible through alliances with developers and users of several different platforms.	Understanding the importance of key personnel – therefore, hiring the best and investing in R&D – Example, hiring the founders of FreeeVu.
DEMAND SIDE	Demand Uncertainty • Internet as a mass communication media • Unclear revenue model – end users are unwilling to pay	Giving key products away free for end users.	Alliances and partnerships with content providers.	Showcase technology and enter competitions to win prestigious awards – creates positive and useful contingencies that can be exploited for garnering market share.
	Market Uncertainty • Open standards = low entry barriers = large number of competitors and large turnover of entry and exit • The role of Microsoft • Evolving technology – both standards and complements	Giving key products away free for end users creates entry barriers.	Alliances with content providers and even acquisitions of potential competitors such as the acquisition of VXtreme through Microsoft.	Push to make RN the standard for streaming media. Using continual PR to exploit positive contingencies such as an industry award helps make the case stronger.
MACRO SIDE	Investor Uncertainty • Need for continual fund raising given uncertain revenue model and negative profits to date	Market share has to take the place of positive profits if investor confidence is to continue. Therefore, continual efforts to bring new versions to market in minimal time is an essential strategy.	Multiple interlocking alliances helps build credibility of long-run survival and shores up investor confidence.	Early IPO to take advantage of the "internet bubble" helps garner large amounts of investments from multiple small stockholders.
	Regulatory Uncertainty • Internet laws only beginning to evolve • Microsoft and its anti-trust problems	Continual innovation makes for good arguments against accusations of anti-trust practices.	Extreme caution in what RN says and does with the Microsoft alliance is key to dealing with possible future regulatory issues.	No a priori "knowledge" of regulatory changes is possible– only continual watchfulness and the ability to deal with contingencies can help.

FIGURE 1

Contrasting the textbook paradigm in marketing with effectuation

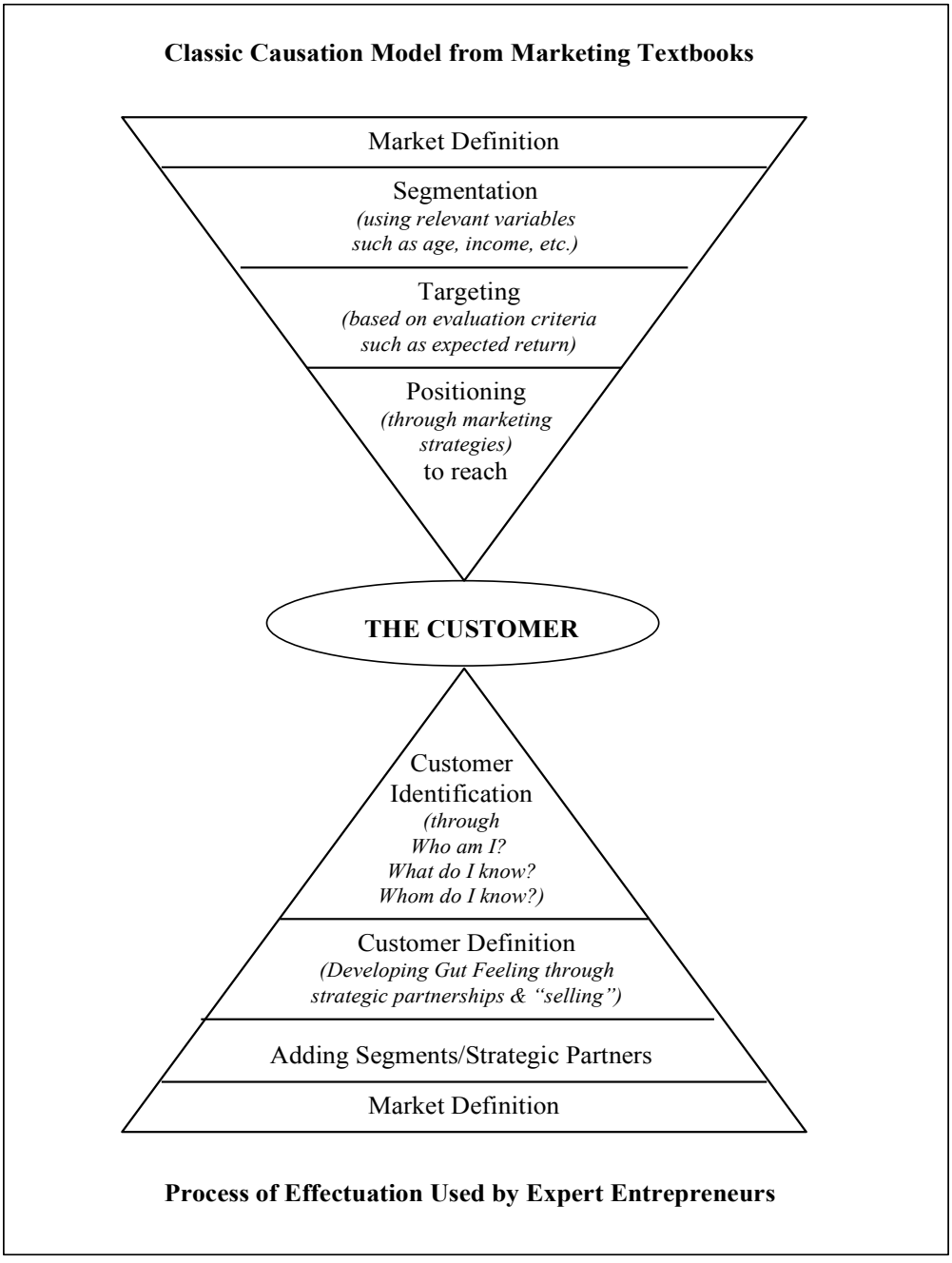

Figure 2:
The RealNetworks Case:
Strategies that use the logic of control to establish brand ubiquity