USING PUBLIC RELATIONS TO GAIN LEGITIMACY IN AN EMERGING MARKET: NANOTECHNOLOGY FIRMS AND THE NEWS MEDIA

by

Sami M Asiri

A Thesis Presented to the
FACULTY OF THE GRADUATE SCHOOL
UNIVERSITY OF SOUTHERN CALIFORNIA
In Partial Fulfillment of the
Requirements for the Degree
MASTER OF ARTS
(STRATEGIC PUBLIC RELATIONS)

December 2006

Dedication

To Margot Jean Wright, for twenty incredible months.

Acknowledgments

This thesis is the product of countless hours of research, discussion, composition and procrastination. Its completion is due, in large part, to the patience and involvement of my outstanding thesis committee. In particular, I would like to thank my Committee Chair, Craig Carroll, for his many contributions to this document and for his endless support throughout its creation.

My heartfelt thanks go to my parents, Guylaine and Abdul-Jabbar, for their continuous love and support and for their unquestioned belief in me. You have taught me to think for myself and given me the courage to pursue my dreams, and for that I am grateful. I must also thank Adam and Daniel, my brothers, for urging me to stay the course and for always reminding of who I am. I may not always show it, but your encouragement means the world to me.

My many friends and peers at Annenberg helped make these last two years the quickest of my life. I will never miss the assignments, the midterms or the finals, but I will miss your company. Let us always stay in touch.

Lastly and especially, to Margot. You made Los Angeles exciting and my time there more rewarding than I could have ever expected. You believed in me, you inspired me and you challenged me to try harder. You were my best friend, my love, my family and everything in between. I could not have done this without you. Thank you!

Table of Contents

List of Tables

List of Figures

Abstract

This thesis provides an initial examination of how firms created in or moving into an emerging market use public relations to legitimize their actions and policies to make them appear useful and responsible to their stakeholders. While past studies have focused largely on news coverage and public perception of emerging markets, this investigation centers on organizations' use of press releases to communicate their activities and set the media agenda about these markets. These ideas are examined in the emerging market of nanotechnology. This study finds that news coverage of diversified firms and non-diversified firms contained very similar themes. Non-diversified firms received a higher than expected proportion of business-themed news coverage whereas diversified firms received a higher proportion of research-themed coverage.

Chapter 1: Introduction

Firms need legitimacy to effectively compete and survive in today's global business environment. Whether these firms are unknown start-ups or well-known corporations, stakeholders must perceive their actions and policies to be useful and responsible for them to succeed (Boyd, 2000). As a result, organizations must steadily communicate and legitimize their purpose and activities to their audiences—investors, politicians, governmental entities, the communities in which they operate, and other businesses—or risk losing necessary support and resources from these stakeholders.

Communicating legitimacy is of particular concern to firms in emerging markets and industries or working with unconventional technologies such as nanotechnology. Novelty subsumes uncertainty, and the unpredictability and inherent risk of the unknown make it more difficult for organizations to appear useful or responsible to their stakeholders. Paradoxically, novelty and uncertainty enhance the allure of certain activities to science writers and journalists (Zehr, 1999). These innovative and innovating firms are consequently faced with conflicting tasks: To develop revolutionary industries or technologies and persuade stakeholders that to do so is both useful and responsible.

Public relations endeavors allow corporations to communicate and legitimize their actions and policies to stakeholders through the news media. The use of this intermediary is important, as corporate messages conveyed through the media are often considered more trustworthy and credible than information

communicated by organizations themselves (Gandy, 1982). News coverage confers prominence on firms (Carroll & McCombs, 2003) and this, in turn, allows firms to appear legitimate and credible in the eyes of their stakeholders.

This thesis, then, explores how firms created in or moving into an emerging market use public relations to legitimize their actions and policies to make them appear useful and responsible to their stakeholders. It examines these firms' actions within the context of nanotechnology, an innovation perceived as both evolutionary and revolutionary with the potential to have an enormous social, political and economic impact (Milunovich, Roy, & Fan, 2004). Nanotechnology is moving past its inception and settling into the mainstream. As such, this is an opportune time to explore how firms—diversified and not—communicate and justify their involvement in new technologies and study how the news media write about them.

The rest of this introduction explores the importance of organizational legitimacy to innovative firms; identifies public relations' role in creating and communicating organizational legitimacy; examines how the news media shape coverage of nanotechnology and of innovative firms; and defines, describes, and examines nanotechnology and some of the societal research surrounding it.

Organizational Legitimacy

Literature on organizational legitimacy has largely emerged from the fields of management and sociology, with some recent contributions from the field of public relations. Suchman (1995) defined legitimacy as "a generalized perception or

assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (p. 574). Legitimacy has alternatively been described as compatibility between an organization's activities and the goals of society (Dowling & Pfeffer, 1975), "a condition reflecting perceived consonance with relevant rules and laws, normative support, or alignment with cultural-cognitive frameworks" (Scott, 2000, p. 59), and "an institution's need for publics to recognize its authority to operate and exercise authority in a broader social context" (Boyd, 2000, pp. 341–342).

Despite their variations, each of these definitions maintain that firms must, in some way, adhere to stakeholder expectations in order to achieve organizational legitimacy. Legitimacy depends significantly on the perceptions of its stakeholders (Boyd, 2000), comprised of both internal and external publics (Roper & Toledano, 2005, p. 480), and exists in varying degrees (Brummer, 1991; Stillman, 1974). In the end, a "significant portion" of a firm's stakeholders must approve of it for the organization to be deemed legitimate (Boyd, 2000, p. 346).

As legitimacy and reputation are often used interchangeably in the field of public relations, it is important to recognize the differences between the two. While both describe stakeholders' perception of organizations, legitimacy refers to the acceptance of a firm based on its adherence to social norms and expectations. Reputation, on the other hand, refers to the comparison of two or more organizations based on a variety of criteria (Deephouse & Carter, 2005).

Legitimacy affects how stakeholders understand and act toward organizations (Suchman, 1995). It allows firms to acquire important resources such

as qualified and experienced employees, capital, technology, partnerships, and governmental support (Pfeffer & Salancik, 1978; Zimmerman & Zeitz, 2002). Never attaining or losing legitimacy could eventually lead to organizational failure (Zyglidopoulos, 2003).

The review of literature on organizational legitimacy differentiates between strategic and institutional approaches to legitimacy (Suchman, 1995). The strategic approach depicts legitimacy as an organizational resource that firms utilize in a purposive and calculated manner to attain their goals. Strategic-legitimacy assumes that managers have a high level of control over their organization's perceived legitimacy and that they manage it through the use of symbols and rituals instead of more substantive actions. In contrast, the institutional approach describes legitimacy as a result of external institutional forces that control how the organization is created, managed, and perceived. Organizations become legitimate by adopting and maintaining pre-existing normative behaviors and characteristics through their actions and structures. Institutional-legitimacy assigns only limited managerial control over legitimacy within the confines of existing organizational sectors.

In this instance, an institutional approach to nanotechnology is most relevant. The high level of uncertainty surrounding nanotechnology makes it difficult for managers to have an adequate level of control over their organization's perceived legitimacy. Instead, firms must reflect stakeholders' perceptions and, to some degree, adhere to their expectations.

Suchman (1995) identifies three types of organizational legitimacy: Pragmatic legitimacy, moral legitimacy and cognitive legitimacy. Pragmatic legitimacy rests on self-interest and the potential value of favorable exchanges or outcomes to key stakeholders. Policies and actions are endorsed because they offer direct benefits to constituents. Support by shareholders for organizational actions such as restructuring and downsizing (Christen, 2005) are likely to stem from pragmatic legitimacy.

Moral legitimacy emerges from a positive normative evaluation of an organization and its activities. Suchman (1995) explains that moral legitimacy is "sociotropic" and is largely determined by whether an action or policy is considered "the right thing to do" by stakeholders. Moral legitimacy is evaluated in one of four ways: Consequential legitimacy, derived from what organizations accomplish; procedural legitimacy, based on stakeholder endorsement of an organization's techniques and procedures; structural legitimacy, acquired through the presence of expected organizational characteristics; and personal legitimacy, which relies on the charisma of a firm's leaders. These value judgments of legitimacy are critical to corporations since they directly reflect stakeholders' beliefs about them. Moral legitimacy would be used to evaluate an organization that downsizes its workforce while raising executive salaries and bonuses (Christen, 2005).

Lastly, cognitive legitimacy is a result of the predictability or taken-for-grantedness of organizations and their actions. Stakeholders accept firms and their activities as legitimate because they make sense and have a proven track record of success or because they have simply always been. Large, diversified multinational

firms such as IBM, Nike, and GE are considered to have cognitive legitimacy. Smaller, lesser known firms, on the other hand, do not typically possess cognitive legitimacy.

Of these three legitimacies, pragmatic legitimacy is least likely to be used in the evaluation of innovative firms at this time. This legitimacy relies on audience self-interest and the technology does not yet offer significant enough value to stakeholders for them to publicly endorse it for those reasons. Moral and cognitive legitimacy, on the other hand, are more societal in nature and more likely to be used by the public to assess organizations working with nanotechnology. As a result, firms wishing to be deemed legitimate must increase their perceived moral and cognitive legitimacy.

Public relations and actional legitimation. Legitimacy is managed primarily through communications (Suchman, 1995) and is "established, maintained, challenged, and defended through dialogues between an organization and its various publics regarding organizational activities and their relation to social norms and values" (Metzler, 2001, p. 322). It is the outcome of persuasive justifications for their actions by corporations (Green, 2004). Organizational legitimacy is, therefore, at the core of most public relations activities (Metzler, 2001).

Public relations scholars have previously examined legitimacy in works about crisis communications (e.g. Benson, 1998; Christen, 2005; Hearit, 1994; Hearit, 1995a; Hearit, 1995b; Ice, 1991; Williams & Treadaway, 1992) and issues management (e.g. Coombs, 1992; Heath, 1997). Crisis communications research has

revolved primarily around reactive communication strategies, such as the reestablishment of organizational legitimacy with firms' multiple stakeholders following a crisis. Corporations in the midst of crises must reaffirm the institutional legitimacy of their organizations at a time when their continued existence might be in question. While this view of legitimacy is certainly relevant to organizational upheavals and unforeseen emergencies, it is not applicable to the everyday realities of corporate existence. A more serviceable approach to consistent organizational legitimacy management emerges from the literature on issues management. Unlike crisis communications, issues management relies on proactive communication strategies (Heath, 1997). As such, legitimacy can be managed more regularly and individual concerns handled independently, with the overall goal of avoiding crises altogether. Coombs (1992) suggests that for issues management efforts to be successful, stakeholders must perceive the issue managers, the advocated policy and the issue itself as legitimate. In the case of nanotechnology, stakeholders would have to find the organization, its actions and policies, and the concept of nanotechnology useful and responsible in order for any activity to be deemed legitimate. Working from this, Boyd (2000) concludes that crises are not the norm and that another kind of legitimacy, actional legitimation, is required to account for day-to-day legitimacy concerns.

In actional legitimacy, Boyd (2000) establishes a more fundamental link between legitimacy and public relations and offers a new area of study to public relations scholars. Building on the concept of institutional moral legitimacy, it focuses on establishing corporate actions and policies as useful and responsible and

gaining support for these endeavors from stakeholders. In this way, actional legitimacy is anchored in Grunig's (1993) theory that public relations requires organizations to build relationships through symmetrical dialogue. By involving stakeholders in organizational activities as they emerge, actional legitimacy promotes the management of legitimacy before crises arise rather than in their aftermath (Boyd, 2000).

Actional legitimation allows organizations to demonstrate the legitimacy of specific corporate actions or policies on a case-by-case basis (Boyd, 2000). First suggested by Brummer (1991), it requires corporations to "justify omission of what is expected…as well as commission of something unexpected" (Boyd, 2000, pp. 348–349). In other words, actional legitimacy is achieved by providing stakeholders with good reasons for each organizational action (Ulrich, 1995, p. 3) and demonstrating that it is the right thing to do.

In the case of nanotechnology, actional legitimation can be used to both explain and promote the technology. Many electronic components found in today's modern computers, such as hard drives and central processing units (CPUs), have increased exponentially in capacity and performance over the last two decades. All the while, advances in the manufacturing process have allowed these devices to become smaller and smaller. CPU transistors are now measured in nanometers and nanotechnology research is vital to continued improvements. As a result, CPU manufactures such as Intel and AMD may use actional legitimation to explain the usefulness of miniaturization (a by-product of nanotechnology) and promote it as

the right thing to do. Smaller and more complex CPUs result not only in increased processing power but also in reduced power consumption and waste.

Through communications with the news media, innovative firms can build a case for the usefulness and responsibility of their actions and policies. Press releases represent an actional legitimacy tool with which firms establish corporate actions and policies as useful and responsible and gain support for these endeavors from stakeholders.

Innovative firms and media legitimacy. Two types of innovative firms exist in the field of nanotechnology. The first, diversified firms, are multi-industry or multi-speciality companies (Zuckerman, 2000). They have been in existence for some time and are typically well-known firms with some brand recognition. These firms' involvement in nanotechnology may or may not be considered legitimate, but they have attained legitimacy in their own industries or specialties and are invested in nanotechnology through research, manufacturing, product design, partnerships, subsidies or acquisitions. Diversified firms working with nanotechnology include IBM, GE, 3M and Intel.

The second type, referred to here as non-diversified firms, are newer firms that have emerged with a primary focus on nanotechnology. Being both generally smaller in size and lesser-known than diversified firms, and working almost exclusively on a technology rife with uncertainty, they have yet to achieve legitimacy of their own. This is not to say that these firms are not at all perceived as legitimate but, rather, that they are not recognized as legitimate by a large enough

number of stakeholders. These firms are also unable to rely on existing institutions to provide them with external legitimacy (Aldrich & Fiol, 1994). For the purposes of this study, non-diversified firms refer only to companies found in the Merrill Lynch Nanotech Index on February 23, 2006 (American Stock Exchange, 2006). Non-diversified firms include Altair Nanotechnologies, Veeco Instruments, and Acacia Research–Combimatrix.

Nanotechnology, being a recently new activity, suffers from low cognitive legitimacy. Indeed, Cobb and Macoubrie (2004) revealed that most Americans have heard little or nothing about nanotechnology. While this is of some concern to all firms involved in nanotechnology, it is of particular relevance to non-diversified firms firms that do not have existing legitimacy on which to rely. Analysts have framed nanotechnology not as a new industry but as a technological evolution emerging within industries as diverse as pharmaceutical, telecommunications and consumer goods (Milunovich, et al., 2004). Non-diversified firms, which can acquire legitimacy indirectly from the industries within which they operate, can therefore position themselves as part of an existing industry rather than an entirely new one (Zimmerman & Zeitz, 2002).

Non-diversified firms can also achieve cognitive legitimacy by visibly championing and implementing recognized methods, models and processes, which are deemed useful and responsible and that are adhered to by diversified firms (Ahlstrom & Bruton, 2001; Aldrich & Fiol, 1994; Suchman, 1995; Zimmerman & Zeitz, 2002). This includes not only corporate functions but other accepted organizational strategies. By mimicking diversified organizations' communication

practices and messages, for example, non-diversified firms can appear more legitimate to the public because of the types of information they convey and the ways in which they do so.

Endorsements are one final method through which organizations can build cognitive legitimacy (Zimmerman & Zeitz, 2002). They are useful to all organizations but are particularly beneficial to new, lesser known firms, as they effectively convey legitimacy from the endorsing organization to the new venture. Positive news coverage is considered a form of endorsement (Abrahamson & Fombrun, 1992; Elsbach, 1994; Fombrun & Shanley, 1990) and in this sense, the news media are legitimizers of new firms and new technologies. By covering them favorably (Carroll & McCombs, 2003), the news media can make non-diversified firms appear useful, responsible and, consequently, legitimate.

Effect of the News Media

The news media help shape which scientific opportunities are accepted, capitalized and commercialized. They decide how issues are framed and conveyed to the public and have the ability to legitimize certain interpretations and actors over others (Anderson, Allan, Petersen, & Wilkinson, 2005; Friedman, Dunwoody, & Rogers, 1999). News frames help determine what exists, what happens, and what matters (Gitlin, 1980). The news media frame emerging technologies by "helping to establish the initial parameters of debate, by identifying certain news sources as pertinent and credible, and by providing topic-defining reference points" (Anderson, et al., 2005, p. 202). They also choose whether to cover new science

positively or negatively (Stephens, 2004), thereby influencing how emerging technologies are perceived by stakeholders (Golan & Wanta, 2001; McCombs, Llamas, Lopez-Escobar, & Rey, 1997). Previous research has established that media coverage of emerging technologies provides a key heuristic to audiences unfamiliar with the technology (Nisbet, Brossard, & Kroepsch, 2003; Nisbet & Lewenstein, 2002) and is a key factor in influencing how the public thinks about nanotechnology (Scheufele & Lewenstein, 2005). Indeed, when new markets are in their infancy, media coverage is one of the few widely available sources of information for reducing uncertainty in these markets (Kennedy, 2003).

By choosing what and who to write about, the news media influence what the public thinks about an issue and helps set how they think about it. This agenda-setting role of the news media refers to journalists' ability to influence the public agenda through their day-to-day selection of news (McCombs & Reynolds, 2002). By conferring prominence on specific issues, topics or actors, the media influences the prominence of those subjects among the public. The media are therefore "propagators" of corporate legitimacy who legitimate organizations by virtue of their coverage (Pollock & Rindova, 2003). By conferring status on certain firms, the news media increases their prominence on the public agenda and their salience among the public (Carroll & McCombs, 2003; Kosicki, 1993; McCombs, et al., 1997; Rogers, Dearing, & Bregman, 1993). This concurrently augments firms' legitimacy and credibility in the public arena (Pollock & Rindova, 2003). Media coverage of emerging technologies not only informs publics about new technologies but also about the firms involved in their development and application.

News coverage of nanotechnology. Nanotechnology coverage has focused largely on the scientific and economic aspects of this new technology (Scheufele & Lewenstein, 2005) and has appeared largely on the financial pages of daily newspapers (Anderson, et al., 2005). Reflecting public opinion, or perhaps shaping it, news coverage of nanotechnology in the United States has been very positive (Gorss & Lewenstein, 2005), with considerably more coverage of its benefits than in the European media (Gaskell, Eyck, Jackson, & Veltri, 2004) and few investigations of its risks (Anderson, et al., 2005; Gorss & Lewenstein, 2005). Of the 54% of news articles that have expressed an opinion about nanotechnology's social implications, 57% have suggested that the benefits outweigh the risks while only 19% believe the opposite (Stephens, 2005). Still, there are some concerns. Unease about public accountability has been a persistent consideration in nanotechnology coverage and may be evidence of the public's lack of trust in public officials and multinational corporations (Cobb & Macoubrie, 2004; Gorss & Lewenstein, 2005).

Early coverage of nanotechnology has been likened to that of biotechnology—beginning with a few stories in elite media outlets such as the *New York Times*, *Wall Street Journal* and *Washington Post*, before rapidly spreading to other outlets (Gorss & Lewenstein, 2005). News stories about nanotechnology in the American press have largely focused on three dominant themes, all of them important to innovative firms: Scientific discoveries or projects (27%), social implications and risks (17%), and nanotechnology as a business story (11%) (Stephens, 2005).

Corporate agenda-building. To a large extent, corporations influence how and what stakeholders think about them, their actions and their policies through agenda-building (Curtin & Rhodenbaugh, 2001) and issue ownership (Meijer & Kleinnijenhuis, 2006) efforts in the news media (Berger, 2001; Carroll & McCombs, 2003; Curtin, 1999). Agenda-building refers to corporations' efforts to influence the media agenda (Curtin & Rhodenbaugh, 2001) while issue ownership relates to organizations' ability to be associated, positively or negatively, with specific issues that are of relevance to it (Meijer & Kleinnijenhuis, 2006).

Firms build an agenda primarily through the distribution of press releases, whether directly, by fax or e-mail, or indirectly, over news wire services such as Business Wire and PR Newswire, to news organizations that write about them. Press releases are an essential vehicle for communicating actional legitimacy as they are designed to provide stakeholders with justifications for organizational actions. Previous research has shown that the media's agenda is highly dependent on the agenda-building efforts of actors and organizations in their areas of interest. McInerney, Bird, and Nucci (2004) showed that press releases announcing achievements in biotechnology foods were a key factor in communicating organizations' points-of-view and increasing public awareness of biotechnology issues. It is estimated that press releases influence as much as 25% to 80% of all news content (Cameron, Sallot, & Curtin, 1997) and that as much as 50% of business news in the *Wall Street Journal* originates from press releases or story suggestions by public relations professionals (Blyskal & Blyskal, 1985). Nearly half

of the news stories in the *New York Times* and *Washington Post* across a 20-year period have been found to be substantially based on press releases (Sigal, 1973). Likewise, studies have found that 85% of environmental reporters rely on press releases for information (Sachsman, 1973; Witt, 1974).

Organizations can also use press releases to associate themselves with and promote their involvement in issues such as nanotechnology. Issue ownership affects the reputation of firms based on the prominence of news coverage about owned issues. That is to say, is there is news about an issue such as nanotechnology that the public perceives the organization to be handling successfully, then the reputation of the organization will improve. If, on the other hand, the firm is not positively associated with the issue, then its reputation in light of that issue will worsen (Meijer & Kleinnijenhuis, 2006). Issue ownership affects organizational legitimacy as well. Reputable firms, by virtue of being closely associated with a specific issue, are more likely to be perceived as legitimate in regards to that issue. For example, stakeholders would be less likely to question the legitimacy of a leading nanotechnology firm's actions and policies than they would a firm not associated with nanotechnology.

Press releases have the ability to not only convey information, but to communicate a corporate agenda and, ultimately, shape the media discourse (Carroll & McCombs, 2003; Curtin & Rhodenbaugh, 2001). They are a tool with which firms establish actions and policies as useful and responsible. By increasing the quantity and helping shape the tone of coverage they receive, organizations increase their ownership of the nanotechnology issue and their salience on the

public agenda. This helps legitimize their actions and policies and make them appear useful and responsible to their stakeholders.

Nanotechnology

Over the last two decades, nanotechnology has been hailed by many as a revolutionary technology that promises to create significantly smaller and faster computers, regenerative medicines composed of microscopic machines, lighter and more durable materials, environmental remediation, and much more. It is expected to apply to a wide number of industries and transform entire industrial sectors while creating new ones (Einsiedel & Goldenberg, 2004). Milunovich et al. (2004), in a research report for Merrill Lynch, explained that:

> We believe nanotechnology is the next logical step in miniaturization.... Building at the nanoscale enables new interactions in materials, semiconductors, and biological agents. The new scale allows manipulation on the atomic and cellular level, which should enable new discoveries in pharmaceuticals, biodefense, and healthcare. (p. 2)

Nanotechnology involves the fabrication of components smaller than 100 nanometers, or about 800 times smaller than the width of a human hair. It is not a new industry, but rather a technological evolution relevant to many existing disciplines such as biology, chemistry, and engineering (Milunovich, et al., 2004).

New technologies such as nanotechnology—and the industries that form around them—have the potential to have tremendous social, political, and economic consequences. The United States Congress has chosen to make nanotechnology a priority, largely because of the perceived potential contributions of nanotechnology to future economic growth. In 2001, it created the National

Nanotechnology Initiative (NNI), a federal research and development program established to coordinate the efforts of 11 different federal agencies in nanoscale science, engineering, and technology. The overall budget for the NNI has increased from $464 million in fiscal year 2001 to over $1 billion in 2005, with an estimated budget of $1.3 billion in 2006. This funding has also been used for the creation of university and government nanoscale R&D laboratories and to help foster cross-disciplinary networks and partnerships.

Nanotechnology is predicted to have a worldwide market size of over $1 trillion annually within the next five to ten years, with revolutionary social and technological improvements in manufacturing, electronics, health care, pharmaceuticals, energy, transportation, and sustainability (Roco & Bainbridge, 2001). Merrill Lynch expects nanotechnology to be "the next growth innovation, similar in importance to information technology over the past 50 years" (Milunovich, et al., 2004).

Understandably then, American businesses have demonstrated a very real interest in the potential of nanotechnology. Well-known diversified corporations such as IBM, GE, 3M and Intel have begun investing in nanotechnology through research, manufacturing, product design, partnerships, subsidies or acquisitions. Likewise, new, lesser-known companies have emerged with a primary focus on nanotechnology, such as Altair Nanotechnologies, Veeco Instruments, and Combimatrix. Nanoscale materials are already available in paints and coatings that protect against corrosions, scratches and radiation, sunscreens and cosmetics, stain-

repellent clothing, and ever-smaller microchips. And this is only the tip of the iceberg.

Societal research into nanotechnology. In addition to the interest it has received from corporate America, nanotechnology has also been the focus of growing attention in the academic and scientific communities. A citation search of *Science Citation Index* using the words "nanotechnology" and "nanoscience" revealed 1,490 academic articles in 527 different sources between 1982 and 2004 (Stephens, 2004). Well-known scientific journals such as *Nature* and *Science* have covered nanotechnology, as have several new journals devoted specifically to nanotechnology.

Because, perhaps, of the interdisciplinary nature of nanotechnology, academic research into nanotechnology has emerged from both the natural and social sciences. Preliminary research into nanotechnology by the the social sciences has focused on the societal dimensions of this emerging scientific issue, in part with the hope that "research on the interactions between nanotechnology and society will help mute speculative hype and dispel some of the unfounded fears that sometimes accompany dramatic advances in scientific understanding" (Roco & Bainbridge, 2001, p. iii). More specifically, this research has focused on the public perceptions (Bainbridge, 2002), public attitudes (Cobb & Macoubrie, 2004; Gaskell, et al., 2004), public acceptance and understanding (Scheufele & Lewenstein, 2005), and news coverage and media framing (Anderson, et al., 2005; Gaskell, et al., 2004; Gorss & Lewenstein, 2005; Stephens, 2004; Stephens, 2005) of nanotechnology.

Previous research has also examined the social evolution and regulation of biotechnology and drawn parallels between it and nanotechnology, suggesting that greater public involvement in the latter may curtail the pitfalls experienced by the former (Einsiedel & Goldenberg, 2004; Mehta, 2004). Social acceptance of nanotechnology is critical to its future development (Roco & Bainbridge, 2001) and sustainability (Einsiedel & Goldenberg, 2004; Mehta, 2004), and is requisite for the legitimization of firms involved in the creation of nanotechnology products and technologies.

Americans' initial reaction to nanotechnology has been generally positive. In separate surveys by Bainbridge (2002) and Cobb and Macourbie (2004), respondents have shown high levels of enthusiasm for nanotechnology research and the possible benefits it may produce. Most Americans have heard little or nothing about nanotechnology yet, even in the absence of scientific or policy-related information, they expect its potential advantages to be more prevalent than its risks, particularly in the detection, prevention and treatment of human diseases (Cobb & Macoubrie, 2004; Scheufele & Lewenstein, 2005). One notable concern about nanotechnology exists less with the technology itself and more with corporations' use of it: Individuals lack trust in business leaders' ability or willingness to minimize nanotechnology risks to human health (Cobb & Macoubrie, 2004).

This lack of trust echoes the consumer backlash that surrounded biotechnology and genetically modified foods in the late 1990s. Building upon the lessons learned from that experience, scholars have encouraged nanotechnology supporters to educate their publics (Roco & Bainbridge, 2005), to resist over-

promoting the technology, and to be proactive rather than reactive in their communication efforts (Burke, 2003; Einsiedel & Goldenberg, 2004). Even so, public confidence cannot be gained by only communicating the benefits and risks of new technologies. Efforts to improve the perceived trustworthiness of institutions have also been found necessary, in the field of biotechnology, to gain public support and acceptance (Heimer, 2001; Siegrist, 2000). In other words, innovative firms must communicate and be recognized as legitimate and trustworthy organizations before they can truly gain support for their nanotechnology endeavors.

Chapter 2: Research Questions

Given the sparse amount of literature available on the topic of nanotechnology in corporate communications and in media coverage, five research questions are explored and six hypotheses are tested to understand how firms use press releases to communicate their activities and set the media agenda about nanotechnology.

Firms communicate their actions, policies, and public agendas in press releases to the news media. Correspondingly, journalists rely on these press releases for story ideas, information, and convenience (Friedman, et al., 1999). It is therefore not surprising that a number of studies have revealed that press releases have a significant influence on news coverage and content (Blyskal & Blyskal, 1985; Cameron, et al., 1997; Sachsman, 1973; Witt, 1974; Sigal, 1973). Carroll and McCombs (2003) posited that organized efforts by corporations to communicate their agenda would result in a significant degree of correspondence between the agenda of these firms and the news media. Based on this hypothesis, it is tenable that an increase in the number of press releases about nanotechnology will result in an upswing in the number of news stories about the subject. Accordingly:

> **H1:** There is a positive relationship between the number of press releases about nanotechnology and the amount of news coverage on the issue.

Both diversified and non-diversified firms are involved in the research and commercialization of nanotechnology products and technologies. However, non-

diversified firms created as a result of nanotechnology research are more singularly focused on nanotechnology initiatives than are diversified firms that have moved into nanotechnology from another market. That having been said, Deephouse and Carroll (2005) hypothesized that organizational size is positively related to the volume of news coverage a firm receives. If this is true, bigger diversified companies with existing reputations will likely have a greater deal of legitimacy and credibility with the news media than will smaller non-diversified firms (Aldrich & Fiol, 1994). As such, diversified firms will be written about more frequently.

> **H2:** Diversified firms will receive more news coverage than non-diversified firms.

Moore's Law posits that "at our rate of technological development, the complexity of an integrated circuit, with respect to minimum component cost, will double in about 18 months" (Moore's law, 2006). As a result of this consistently rapid evolution, the electronics sector in general and the semiconductor sector in particular remain at the cutting edge of innovation, always developing newer processes with which to create ever smaller components. In the last few years, nanotechnology has become an integral part of the semiconductor sector with the move to sub-100nm manufacturing processes. The rapid rate of change and consistent rate of discovery in the electronics industry will likely result in increased news coverage for firms operating in that area.

H3: Firms in the electronics industry will receive more press coverage than firms in other industries.

Since non-diversified firms are heavily invested in nanotechnology endeavors, the bulk of their press releases will focus on nanotechnology. Diversified firms are nevertheless more prominent than non-diversified firms and, as a result, non-diversified firms seeking to increase their credibility and legitimacy must become more visible. The news media can make these firms more prominent by writing about them (Carroll & McCombs, 2003) but, to do this, journalists must first become aware of them and of their actions. Press releases allow non-diversified firms to convey this information and, consequently, to increase their prominence. While diversified firms with nanotechnology initiatives will certainly communicate their activities to the media, it is expected that non-diversified firms, with their focus on nanotechnology, will issue the bulk of press releases about the subject. As a result:

H4: Non-diversified companies will be mentioned more often than diversified firms in nanotechnology press releases.

The *National Nanotechnology Initiative* posits that "nanotechnology has the potential to profoundly change our economy and to improve our standard of living, in a manner not unlike the impact made by advances over the past two decades by information technology" (National Nanotechnology Initiative, n.d.). Given this potential impact, and recognizing that the private sector is likely to lead

nanotechnology advances, it is important to identify which firms are most prominently involved in the development of nanotechnology and recognize the extent to which they publicly communicate, or have communicated for them, their activities in this new "economy." The first research question explores these two scenarios:

> **RQ1a:** To what extent are non-diversified firms and diversified firms publicly identifed as companies that execute nanotechnology activities?
>
> **RQ1b:** To what extent do non-diversified firms and diversified firms publicly identify themselves as firms that execute nanotechnology activities?

The media confer legitimacy on organizations by virtue of their coverage (Pollock & Rindova, 2003). Diversified firms and non-diversified firms wishing to gain legitimacy in regards to nanotechnology must therefore communicate their involvement with nanotechnology. However, because of available resources, corporate strategies, and corporations' desired positioning on nanotechnology, these communications might differ. The second research question, then, examines whether larger, more diversified companies communicate their nanotechnology endeavors differently than smaller non-diversified firms:

> **RQ2:** Do diversified and non-diversified firms differ in how they present themselves to the media?

While it is expected that non-diversified firms will be identified more often in nanotechnology press releases than diversified firms, it is conversely anticipated

that the range of nanotechnology themes covered in the communications of non-diversified firms will be narrower than those of diversified corporations. Large, diversified corporations such as IBM and Intel are less likely to communicate nanotechnology from one or two perspectives, whereas non-diversified firms may choose to focus on themes, such as business and technology, that highlight their belonging and legitimacy. Because of their existing experiences with novel technologies, diversified firms will be more likely to know to highlight the technological and business perspectives as well as the societal ones. As a result:

> **H5:** The press releases of diversified companies will cover a wider range of nanotechnology topics than those of non-diversified companies.

Having identified how diversified and non-diversified firms differ in their communication of nanotechnology endeavors, it is important to examine if and how the news media distinguish them. The third research question investigates this:

> **RQ3:** How does news coverage of non-diversified firms differ from that of diversified firms?

Nanotechnology continues to be an emerging market and coverage of nanotechnology has undoubtedly increased since 2004. Previous research has shown that American media coverage of nanotechnology in the *New York Times*, *Washington Post*, *Wall Street Journal* and *Associated Press* is framed more positively

than negatively, with a heavier emphasis on the potential benefits of this new technology and a lesser focus on its risks (Gaskell, et al., 2004; Gorss & Lewenstein, 2005). Comparatively, coverage of nanotechnology in the United Kingdom is more negative than positive, with discussions of the risks outweighing those of the benefits (Gaskell, et al., 2004). Both studies employed human coders to determine the tone of the news articles whereas the present study proposes using a set of computer programs developed for content analysis of verbatim text. As tone is a subjective measure not well suited to computer-assisted text analysis, the fourth research question examines the news coverage of nanotechnology in regards to its benefits and risks. Therefore:

> **RQ4:** Is news coverage more focused on the benefits or on the risks of nanotechnology?

Gaskell et al. (2004) revealed that media coverage of nanotechnology has been framed more positively in the U.S. than in the U.K. This polarization was most apparent between 2002 and 2003, when coverage of risks and benefits increased in both the U.S. and the U.K. Likewise, Gorss and Lewenstein (2005) showed that U.S. newspaper coverage of nanotechnology has been overwhelmingly positive, focusing on the progress and potential economic benefits of this new technology, with little discussion of risks. The American news media habitually focuses on the controversial aspects of issues, thus it seems likely that nanotechnology will be increasingly scrutinized for both its true benefits and its real risks as the field develops (Friedman, et al., 1999; Scheufele & Lewenstein, 2005; Nisbet &

Lewenstein, 2002). While Americans are generally favorably predisposed to nanotechnology (Cobb & Macoubrie, 2004), there is a considerable lack of trust by the public that business leaders will appropriately manage the risks to human health posed by this new technology. As this skepticism enters the mainstream, it seems probable that:

> **H6:** Coverage of nanotechnology will focus more on risks in recent coverage (2003-2005) than it has in earlier coverage (1989-2002).

The final research question focuses on the communication methods of firms involved in nanotechnology. Carroll and McCombs (2003) explain that press releases are a nearly universal tactic for courting media coverage and imforming reporters about corporate endeavors. As such, firms looking to communicate their involvement with nanotechnology would do so, at least partially, through press releases. Press releases may influence as much as 25% to 80% of all news content (Cameron, et al., 1997), including as much as 50% of business news in the *Wall Street Journal* and nearly half of the news stories in the *New York Times* and *Washington Post* over a 20-year period (Sigal, 1973). They are a significant source of knowledge for journalists, with 85% of environmental reporters relying on press releases for information (Sachsman, 1973; Witt, 1974). To identify the effectiveness of press releases in setting the media agenda, the following final question is posed:

> **RQ5:** What percentage of firms' press releases achieved media coverage?

Chapter 3: Methods

Research Objective

This investigation's primary goal is to examine how firms created in or moving into an emerging market use public relations to legitimize their actions and policies to make them appear useful and responsible to their stakeholders. More specifically, this study will look for differences in how diversified firms and non-diversified firms communicate their nanotechnology activities and set the media agenda about nanotechnology.

This goal will be accomplished through the analysis of news coverage and corporate press releases about nanotechnology. The news media help shape what matters through the inclusion or exclusion of news (Gitlin, 1980). They influence how issues and actors are perceived (Anderson, et al., 2005; Friedman, et al., 1999; Golan & Wanta, 2001; McCombs, et al., 1997; Stephens, 2004), guide the public agenda (Nisbet, et al., 2003; Nisbet & Lewenstein, 2002) and help legitimize organizations (Zimmerman & Zeitz, 2002). Press releases convey corporate agendas (Curtin & Rhodenbaugh, 2001) and associate organizations with certain issues (Meijer & Kleinnijenhuis, 2006). They can affect news coverage and often allow organizations to communicate indirectly with their stakeholders (Blyskal & Blyskal, 1985; Cameron, et al., 1997; McInerney, et al., 2004; Sachsman, 1973; Sigal, 1973).

Sample and Data Sources

Companies. A list of 943 public and private companies, universities, research institutions, foundations, and governmental entities involved in nanotechnology in the United States was obtained from Nanovip.com (n.d.) and the Merrill Lynch Nanotech Index (American Stock Exchange, 2006). Companies were compared against firm mentions in news coverage and press releases about nanotechnology from 1986 to 2005 using the VBPro text analysis program (Miller, 1995). Companies that were not mentioned in any of these texts were eliminated from the list, as were universities, research institutions, foundations, and governmental entities. A final sample of N=420 public and private companies was retained for analysis.

Nanovip.com, launched in November 2003, is a web-searchable, human edited database of nanotechnology companies sorted by country and business sector. Nanovip.com provides a listing of all companies involved in nanoscale interaction, manipulation, observation and fabrication—regardless of companies' level of involvement in these endeavors. This listing includes start-ups which specialize in specific nanotechnologies and existing corporations that are incorporating nanotechnology into their operations or investing in nanotechnology research. It also includes governmental entities and initiatives researching nanotechnology, venture capital and investment firms that have investments in nanotechnology, law firms with nanotechnology practices, and universities and research centers conducting nanotechnology research.

The Merrill Lynch Nanotech Index provides a "diversified representation of nanotechnology stocks and ADRs [American Depositary Receipts] traded in the

United States" (Milunovich, et al., 2004, p. 2). Table 1 presents the 27 companies included on the Merrill Lynch Nanotech Index on February 23, 2006. Firms in the technology (41%), healthcare (22%), and materials (15%) sectors make up the bulk of the index. The services (11%), financial (7%) and industrial goods (4%) sectors represent the final quarter of the companies listed.

Table 1. Merrill Lynch Nanotech Index.[1]

Company name	Symbol	Sector	% Weighting
Altair Nanotechnologies	ALTI	Basic materials	5.17%
Westaim Corp	WEDX	Financial	4.65%
Amcol Intl	ACO	Industrial goods	4.61%
Arrowhead Research	ARWR	Services	4.54%
Nanophase Technologies	NANX	Basic materials	4.32%
Novavax Inc	NVAX	Healthcare	4.21%
Flamel Technologies Ads	FLML	Healthcare	4.13%
Ultratech Inc	UTEK	Technology	4.13%
pSivida Ltd. (ADS)	PSDV	Technology	3.88%
Veeco Instruments	VECO	Technology	3.85%
Lumera Corp	LMRA	Technology	3.78%
MTS Systems	MTSC	Technology	3.72%
Headwaters Inc.	HW	Basic materials	3.69%
Cabot Corp	CBT	Basic materials	3.63%
Symyx Technologies	SMMX	Services	3.59%
Acacia Research-Combimatrix	CBMX	Services	3.57%
NVE Corp	NVEC	Technology	3.55%
Nanogen Inc	NGEN	Healthcare	3.50%
FEI Co	FEIC	Technology	3.36%
Biosante Pharmaceuticals	BPA	Healthcare	3.35%
Harris & Harris Group Inc	TINY	Financial	3.31%
Tegal Corp	TGAL	Technology	3.31%
JMAR Technologies	JMAR	Technology	3.22%
Immunicon Corp	IMMC	Technology	3.00%
Pharmacopeia Inc	ACCL	Healthcare	2.72%
Skyepharma Plc Ads	SKYE	Healthcare	2.66%
Kopin Corp	KOPN	Technology	2.53%

1. The Merrill Lynch Nanotech Index at 5 p.m. on February 23, 2006.

To be included in the Merrill Lynch Nanotechnology Index, companies must "indicate in public documents that nanotechnology initiatives represent a significant component of their future business strategy" (Milunovich, et al., 2004, p. 2). Companies must be listed on a national exchange or quoted on the NASDAQ National or NASDAQ Small Market systems and must be considered nanotechnology-driven by the investing community. For these reasons, the Merrill Lynch Nanotechnology Index excludes companies with nanotechnology investments such as IBM, General Electric or Intel. The index is rebalanced and companies are added or removed on a quarterly basis, at Merrill Lynch's discretion. The index is not an investable product.

News content. News coverage of nanotechnology is in its infancy and the topic has only recently begun to appear regularly in mainstream newspapers (Gaskell, et al., 2004; Gorss & Lewenstein, 2005). To assess the content of nanotechnology coverage by the news media, a content analysis was conducted on the *New York Times*, *Los Angeles Times*, *Washington Post*, and *Wall Street Journal*.

These four newspapers were chosen because they are among the five leading daily newspapers in the country (Editor & Publisher, 2003). Weis (1974) showed that leaders in America—irrespective of sector or political affiliation—focus most on coverage in the *New York Times*, *Wall Street Journal*, and *Washington Post*. The choice of these media is also based on Gitlin's (1980) observations that stories in elite media ultimately set the national news agenda by spreading to regional news outlets. While the importance of each of these publications may have shifted with

the rise of 24/7 news channels and the Internet, they remain among the three most read dailies in the country.

The semiconductor and biotechnology industries, which account for 30% of the companies in the Merrill Lynch Nanotech Index, have a strong presence on the West Coast. The *Los Angeles Times* was chosen because it is a top five newspaper (Editor & Publisher, 2003) and because of its status as the leading newspaper on the West Coast.

Searches for news articles containing the words "nanotechnology" or "nanotech" or "nanoscale" or "nanoscience" (Table 2) were performed in the Factiva online database for all four newspapers for the period 1 January 1980 to December 31 2005. The search returned 740 results. The first newspaper article about nanotechnology was an August 10, 1986 *New York Times* book review of Erik Drexler's predictions about molecular nanotechnology and molecular manufacturing, *Engines of Creation*.

Table 2. Nanotechnology search terms.

Search terms
nanotechnology, nanotech, nanoscale, nanoscience

Having removed book reviews and obituaries, the final sample contained N=610 relevant articles over almost two decades, with the bulk of the coverage occurring between 2000 and 2005 (Table 3). News stories in the sample were consequently machine coded using the VBPro text analysis program (Miller, 1995)

for story content and to identify the frequency of mention and presence or absence of companies.

Table 3. Total number of articles about nanotechnology in the New York Times, Los Angeles Times, Washington Post, and Wall Street Journal (1986–2005).

Year	New York Times	Los Angeles Times	Washington Post	Wall Street Journal	Total
1986	0	0	1	0	1
1987	0	0	1	0	1
1988	1	1	0	0	2
1989	0	0	2	0	2
1990	1	2	4	0	7
1991	2	1	0	0	3
1992	0	0	0	1	1
1993	0	0	0	0	0
1994	1	2	0	0	3
1995	2	0	1	0	3
1996	3	1	1	0	5
1997	5	6	3	2	16
1998	3	4	0	0	7
1999	8	0	6	6	20
2000	26	17	11	6	60
2001	19	4	8	4	35
2002	25	13	14	21	73
2003	55	14	25	17	111
2004	52	17	29	37	135
2005	41	13	41	30	125
Total	**244**	**95**	**147**	**124**	**610**

Press releases. Press releases are a recognized and effective tactic for courting media coverage and providing information about corporate endeavors to reporters (Carroll & McCombs, 2003). Firms that want to communicate corporate information to the news media—be it earnings, product launches, new research, or involvement in nanotechnology—will look to do so, at least partially, through the

use of press releases. Nelkin (1995) observed that science writers tend to rely heavily on routine channels of communication within the scientific community, including press releases, for story leads. Cameron, Sallot and Curtin (1997) estimated that press releases influence as much as 25–80% of news content. To identify which companies communicate their involvement with nanotechnology and how they do so, a content analysis was conducted on nanotechnology-related press releases in *PR Newswire* and *Business Wire*.

Searches for press releases containing the nanotechnology search terms (Table 2) were performed in the Factiva online database for both news distribution services for the period 1 January 1980 to December 31 2005. The sample contained 5,436 press releases beginning in January 1993, however, after manual elimination of such items as roundups and conference listings that contained only passing mentions of the search terms, N=5,337 press releases remained for analysis (Table 4). No attempts were made to identify or manipulate duplicate press releases across the news distribution services.

Press releases were machine coded for content using the VBPro text analysis program (Miller, 1995) to identify the frequency and presence or absence of companies.

Themes. For this study, the theme of a news story or press release is simply its topic. A story or news release can have more than one theme. Measuring themes in these texts provided an indicator of the types of discussions being presented by journalists and corporations in relation to nanotechnology.

Table 4. Total number of press releases about nanotechnology in PR Newswire and Business Wire (1993–2005).

Year	PR Newswire	Business Wire	Total
1993	3	1	4
1994	3	9	12
1995	2	3	5
1996	5	6	11
1997	14	9	23
1998	16	8	24
1999	28	29	57
2000	56	62	118
2001	104	111	215
2002	297	305	602
2003	405	382	787
2004	601	950	1,551
2005	645	1,283	1,928
Total	**2,179**	**3,158**	**5,337**

Previous research into the public and nanotechnology have largely focused on the perceived potential benefits and risks of nanotechnology to individuals and society (Bainbridge, 2002; Cobb & Macoubrie, 2004; Scheufele & Lewenstein, 2005). Gorss and Lewenstein (2005) revealed that news coverage of nanotechnology was overwhelmingly positive, but that the news frame of public accountability appeared early in nanotechnology coverage and remained a significant element throughout.

The themes in Cobb and Macoubrie's (2004) and Scheufele and Lewenstein's (2005) explorations of benefits and risks have been those of novelty, privacy, the economy, the environment, health, security and defense, and human interest. Gorss and Lewenstein's (2005) study of news coverage focused on five themes: Application (proposed and actual uses of nanotechnology), policy (current

legislation), politics (bipartisan support disagreement and issues of federal monies), financial (investment reports, economic opportunities), and safety and risks.

This research adapts the themes from these previous studies and adds leadership as a new theme in an attempt to identify which companies are staking leadership positions in nanotechnology (Table 5).

Table 5. Theme dictionary.

Themes	Keywords
Leadership	leadership, leader, leaders, best, lead, first, CEO, chairman, expert, experts
Business	market, statements, product, products, investors, investor, acquisition, partnership, collaboration, funding
Earnings	earning, earnings, results
Research	research, development, explore
Politics	government, state, federal, politics, political
Policy	policy, legislation
Privacy	privacy
Security	security, defense, homeland, space, war
Progress	new, future, innovative, revolutionary, revolution
Environment	environment, environmental, nature
People	people, human, public
Health	health, healthy, healing, medical, medicine, medicines, drug, pharmaceutical, pharmaceuticals, healthcare, patients
Benefits	benefit, benefits, benefiting, benefited, beneficial, beneficially, practical, potential, important, importance, advance, advances, advancement, advancements, advancing, improve, improving, improved, improvement, improvements, reduce, reduced, reduces, better, best, opportunities, opportunity, good, treatment
Risks	caution, cautions, cautious, cautionary, difficulty, difficult, difficulty, difficulties, harm, harmful, danger, dangerous, dangers, threat, threats, threatening, invasive, risk, risks, risky, bad, issue, issues

Instruments. News coverage and press releases of nanotechnology were analyzed using VBPro (Miller, 1995), a set of computer programs developed for content analysis of verbatim text. VBPro allows for the qualitative analysis of texts by inspecting key terms—phrases or words—in context. The search function, used for this analysis, flags key terms in news coverage and press releases. VBPro also facilitates the quantitative analysis of texts, through the coding function, by identifying frequencies of words and coding text—by sentence, paragraph, or user-defined cases—into numeric output for analysis in standard statistical packages.

VBPro accomplishes its searching and coding functions through the use of user-defined category and keyword dictionaries. Categories can contain multiple keywords. For this study, three dictionaries were used: One dictionary containing all companies and their common variations (Appendix A), a second containing theme categories and their descriptive keywords (Table 5), and a third containing relevant nanotechnology keywords (Table 6).

Table 6. Nanotechnology dictionary.

Dictionary	Keywords
Nanotechnology	nano, nanobot(s), nanoelectronic(s), nanofabrication, nanolithography, nanomachine(s), nanomaterial(s), nanoparticle(s), nanorobot(s), nanoscale, nanoscience(s), nanotech, nanotechnology, nanotube(s), nanowire(s)

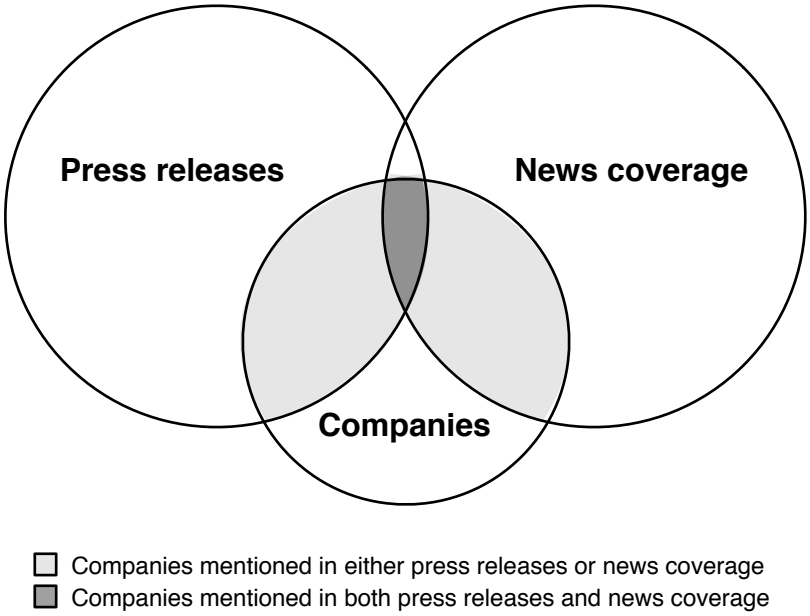
Procedures

Texts comprising news articles and press releases were downloaded from the Factiva online database and formatted using VBPro's formatting function. The

alphabetizing function was used to list all words appearing in the texts and to establish their frequencies. Words that I deemed relevant with a frequency equal to or greater than 500 were identified and grouped by theme (Table 5). To help ensure accuracy of meaning, texts were binary coded, by paragraph, for mentions of the keywords. The first ten paragraph results for each keyword were human analyzed to verify theme classification. Keywords that were deemed accurate in 70% of instances were retained. Plurals and word tenses of keywords were included in the theme dictionary (i.e. benefits, benefiting, benefited, beneficial, beneficially).

To reduce the sample of companies, VBPro's search function was used to compare the initial list of 943 companies against mentions of these firms' names in news coverage and press releases about nanotechnology (Figure 1).

Figure 1. Identifying the final samples of companies.



The search included company names (e.g. General Electric, Hewlett-Packard, International Business Machines), known acronyms (e.g. GE, HP, IBM) and spelling variations (e.g. G.E., Hewlett Packard, H.P., I.B.M.). Only firms that were mentioned in at least one news article or press release were retained as part of the final sample of companies. Firms were then categorized by company name, with firm names, known acronyms and spelling variations grouped into each category (Appendix A).

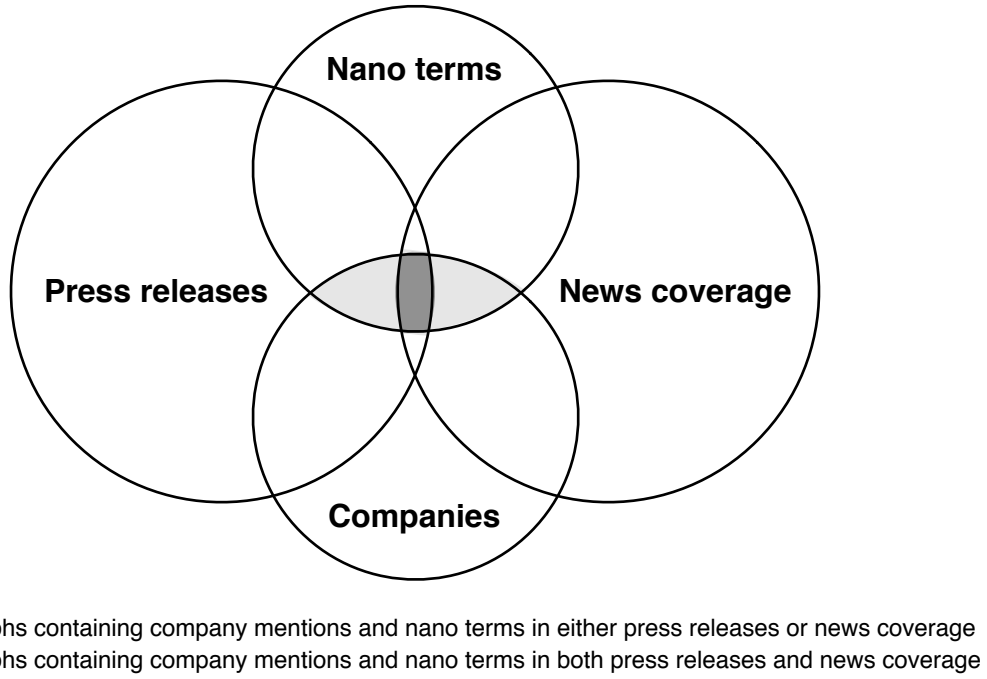
VBPro's binary coding function was used to code news coverage and press releases by case to identify the number of times each company appeared in a text. For example, a search for the category "General Electric" would flag each news article or press release in which the words General Electric, GE or G.E. appeared, regardless of frequency, with a one (1). Texts flagged with a zero (0) would indicate that the company did not appear in that new coverage or press release case.

To establish the extent to which companies publicly identified themselves as firms that executed nanotechnology activities, texts were binary coded, by paragraph, for keywords from both the company and nanotechnology dictionaries (Figure 2). For example, a paragraph containing both "G.E." and "nanotechnology" would count as a public identification, by General Electric, of its involvement in nanotechnology. As such, this paragraph would be flagged with a one (1). Paragraphs that did not contain keywords from the company and nanotechnology dictionaries were flagged with a zero (0).

The New Oxford American Dictionary (McKean, 2001) defines a paragraph as "a distinct section of a piece of writing, usually dealing with a single theme and indicated by a new line, indentation, or numbering". Therefore, it is likely that

companies mentioned in paragraphs about nano activities would be discussed in relation to nanotechnology.

Figure 2. Identifying paragraphs containing firm names and nano terms.

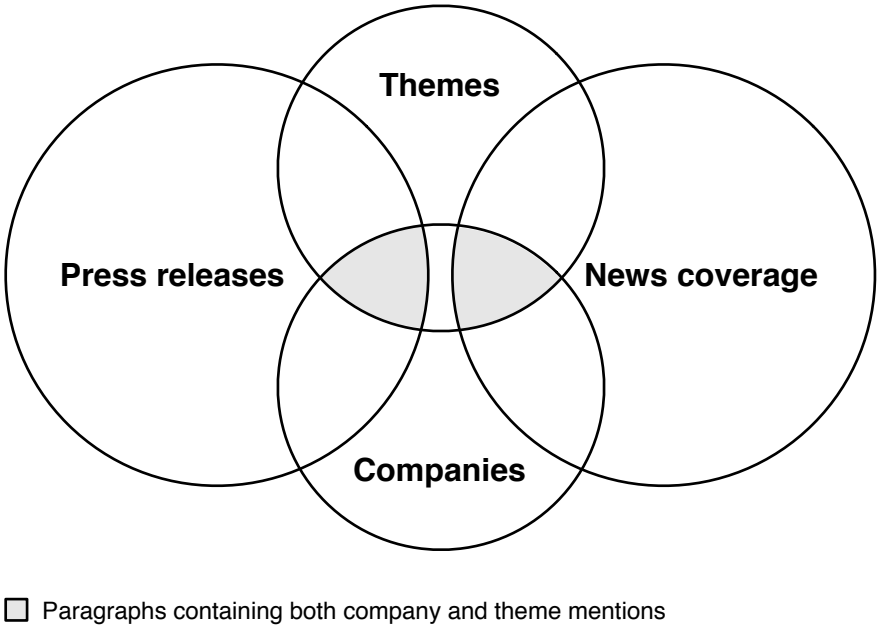


News coverage and press releases were initially searched for in Factiva using the words "nanotechnology", "nanotech", "nanoscale" and "nanoscience" to limit false positives in the search results. False positives, or Type 1 errors, refer to "documents that are retrieved by a [database] search despite their irrelevance to the search question" (False positive, 2006). Since the documents in the final sample were already identified as being nanotechnology related, however, they were queried for other nano-related words. This was done in order to identify companies that might be discussing nanotechnology, but not doing so using the limited

vocabulary used in this study. For example, in press releases, companies might use words such as nanoparticles, nanomaterials, or nanoelectronics to describe their initiatives. Each of these words refers to nanotechnology and should be identified, much as e-business, e-commerce, and e-mail all refer to activities or communications over electronic systems. VBPro was used to alphabetize the press release sample to identify 15 frequently used nanotechnology terms, including the three terms used in the initial search (Table 6).

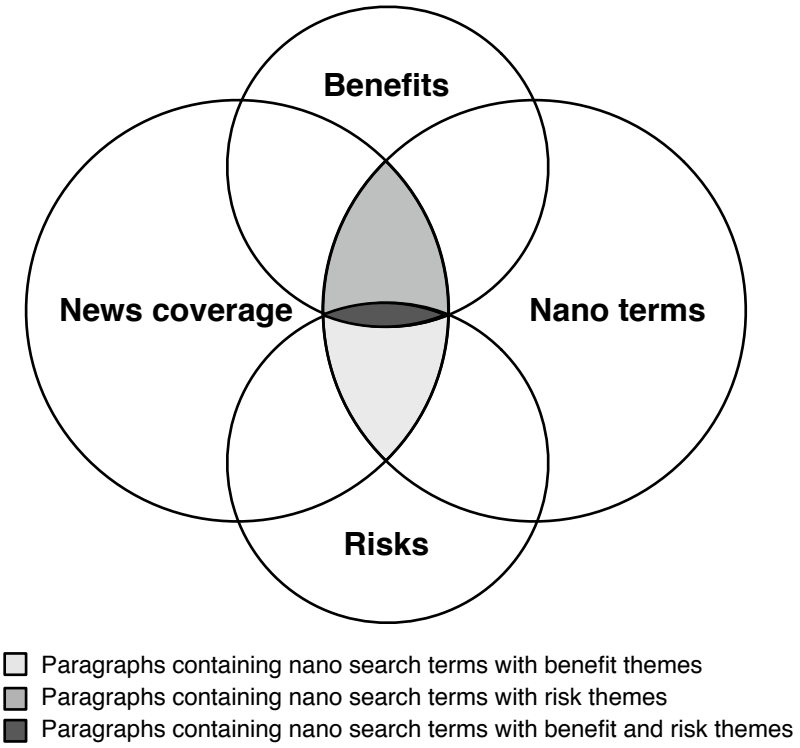
To identify how diversified and non-diversified firms present themselves to the media, press releases were binary coded, by paragraph, for mentions of both companies and themes. News coverage was coded in the same manner to establish how the news media discuss these companies (Figure 3).

Figure 3. Identifying paragraphs containing firm names and themes.



To identify whether news coverage of nanotechnology discussed benefits or risks, news articles were binary coded, by paragraph, for keywords from the nanotechnology dictionary and the benefits and risks categories in the theme dictionary. News discussions of nanotechnology using words such as advancements, improvements and opportunities were deemed to represent benefits. Coverage that used words like caution, harm or difficulty were deemed to signify risks.

Figure 4. Identifying theme of coverage (benefits or risk)



News coverage about benefits and risks was further aggregated into annual measures suitable for statistical analysis using the Janis-Fadner coefficient of imbalance (Janis & Fadner, 1965). The coefficient measures the relative proportion

of favorable to unfavorable assessments while controlling for the overall volume of assessments. As suggested by Deephouse (2000), the resulting variable is called the *coefficient of media favorableness*.

$$\text{Coefficient of media favorableness} = \begin{cases} (f^2 - fu)/(total)^2 \text{ if } f > u; \\ 0 \text{ if } f = u; \\ (fu - u^2)/(total)^2 \text{ if } u > f; \end{cases}$$

In the formula, f = the number of articles containing benefit assessments; u = the number of articles containing risk assessments; and *total* = the total number of articles containing benefit and risk assessments. The range of the resulting variable is (-1, 1), where 1 indicates coverage composed of only benefits, -1 indicates coverage composed of only risks, and 0 indicates a balance between the two over the year. News stories containing both benefit and risk assessments were coded as containing one of each.

Lastly, to establish the percentage of press releases that achieved media coverage, or the conversion rate, news articles about the 30 most mentioned firms and press releases by the 30 most active firms were searched using the company dictionary. News articles that contained firm mentions were flagged and a search was performed for press releases distributed by those firms up to 30 days before the appearance of the article. If a press release was found, the researcher then read both the release and the article to identify commonality. More generally, news articles were also examined to identify influence by public relations practitioners. Public relations influence was ascertained whenever a company employee, spokesperson or

executive was quoted, a corporate profile was written, or a press release was covered after 30 days. Media mentions of past corporate actions were not included as influences because of the difficulty of linking them directly to public relations activities.

Since news coverage of nanotechnology has only recently begun to appear regularly in mainstream newspapers (Gaskell, et al., 2004; Gorss & Lewenstein, 2005) and because of the relatively small number of news articles per year in the sample, press releases were given 30 days to appear in news coverage. This time span increases the likelihood that trend-related or investigative news stories that incorporate press release information will be identified. To the best of the researcher's knowledge, no other studies have attempted to demonstrate a direct link between individual press releases and news stories.

Chapter 4: Results

Since public discussions about nanotechnology by firms and the news media are still relatively new, this study presents only descriptive observations of the data. News coverage of nanotechnology began in earnest in 1998, rising from fewer than a dozen articles a year to 135 in 2004 (Figure 5).

Figure 5. News coverage of nanotechnology by the New York Times, Los Angeles Times, Washington Post, and Wall Street Journal (1986–2005).

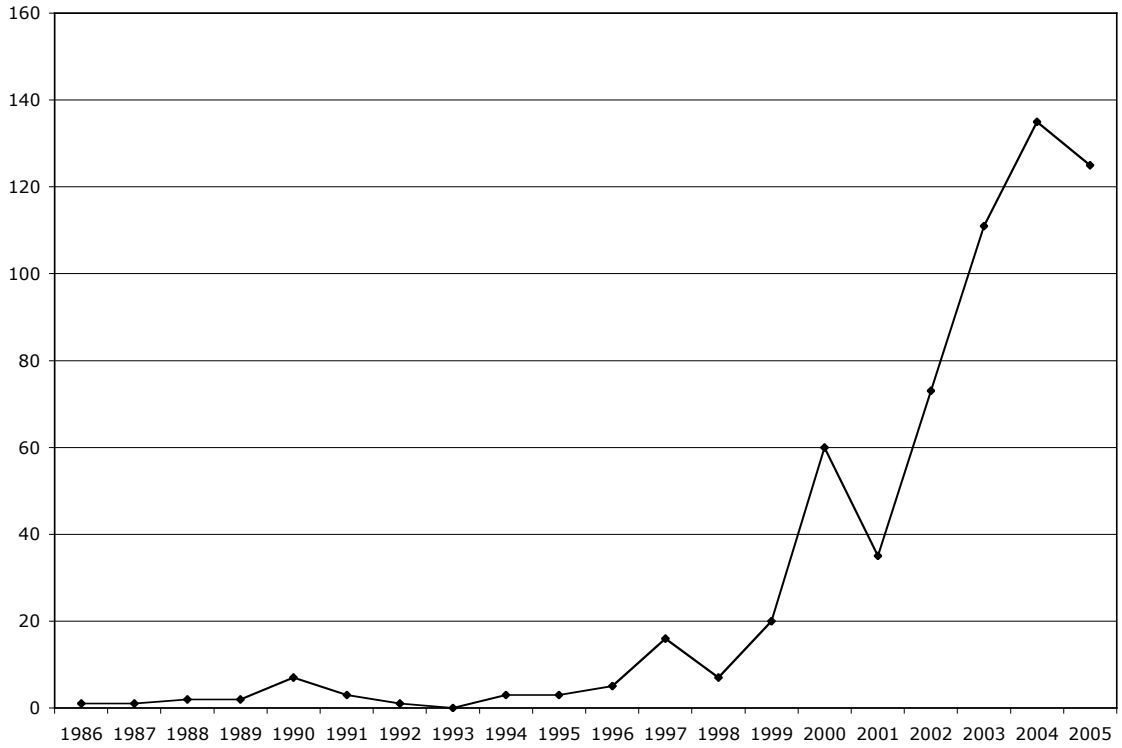
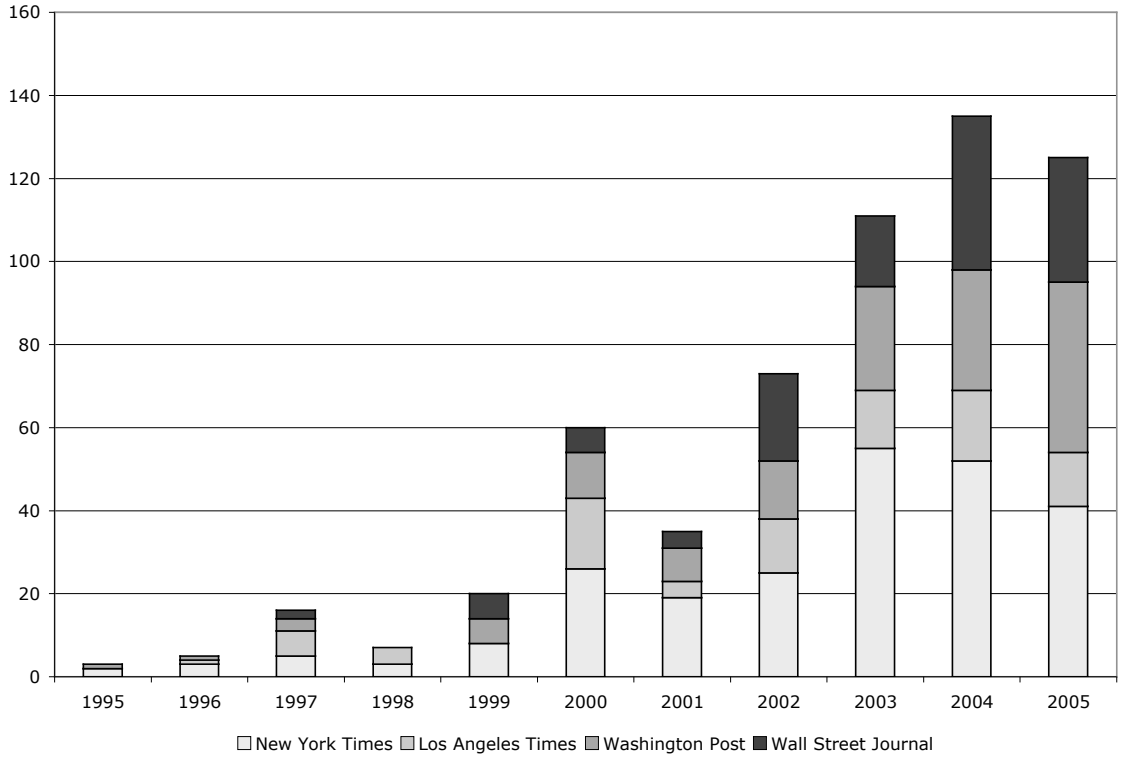


Figure 6 shows that dips in 2001 and 2005 are a result of generally fewer nanotechnology articles by all sampled publications in those years. Previous

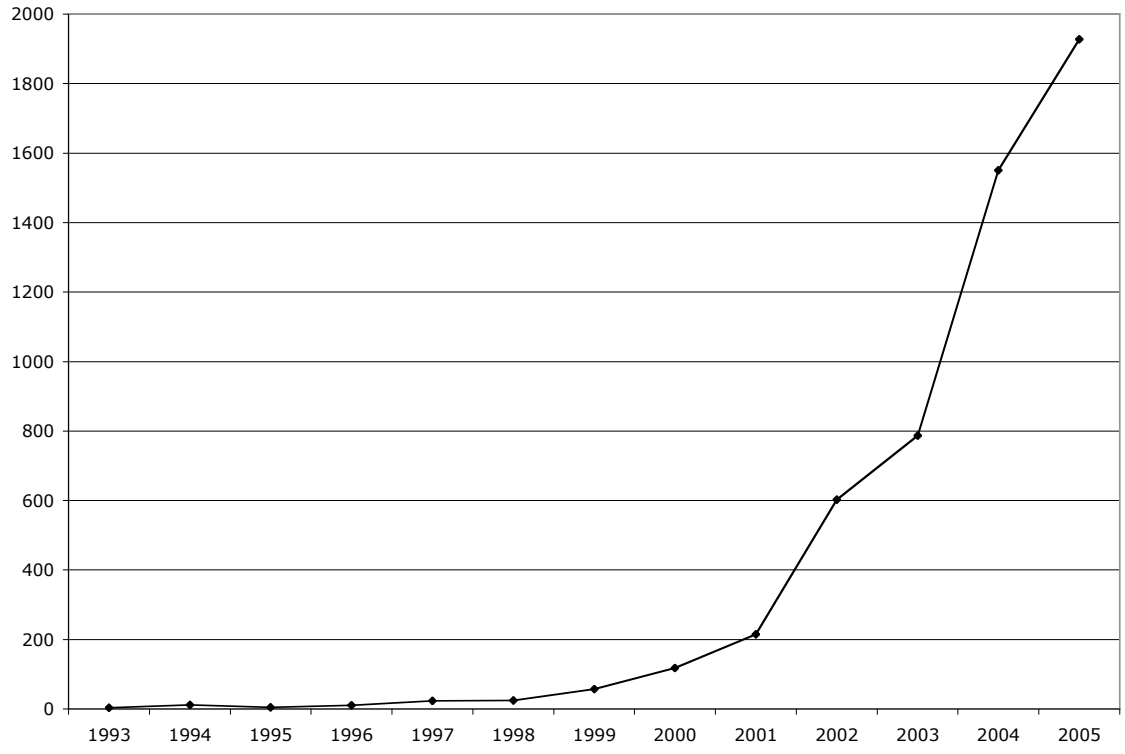
research into the news coverage of nanotechnology (Gorss & Lewenstein, 2005) did not show these fluctuations. Notwithstanding the substitution of one publication (*Associated Press* for *Los Angeles Times*), this difference might be attributed to using the Factiva database for all article searches instead of selectively choosing Factiva or LexisNexis for various sources. A rapid examination of the two databases revealed that, in identical searches of the same publication, Factiva returns fewer articles than LexisNexis. Future studies might want to explore the reasons for this.

Figure 6. Number of articles by publication beginning in 1995.



Press releases about nanotechnology increased at an even faster rate than that of news coverage, almost doubling every year from two dozen in 1998 to 1,928 in 2005 (Figure 7).

Figure 7. Nanotechnology related press releases in PR Newswire and Business Wire (1993–2005).



The number of press releases about nanotechnology in *Business Wire* and *PR Newswire* grew at a similar rate until 2004, when the number of releases in *Business Wire* increased by almost 2.5% year over year (Figure 8). At first, this was attributed to the possible enforcement of the Sarbanes-Oxley Act of 2002, which imposes

additional disclosure requirements on companies. However, while there is more than a three-fold rise in the number of financial disclosures in *Business Wire* from 2003 to 2004, the ratio is only slightly lower in *PR Newswire*. In 2005, the number of press releases in *Business Wire* again increased at a faster rate than in *PR Newswire*, indicating, perhaps, a preference for this outlet by firms working with nanotechnology. Future research should attempt to discern whether one distribution service is generally preferred over the other by corporations.

Figure 8. Number of press releases by distribution service beginning in 1997.

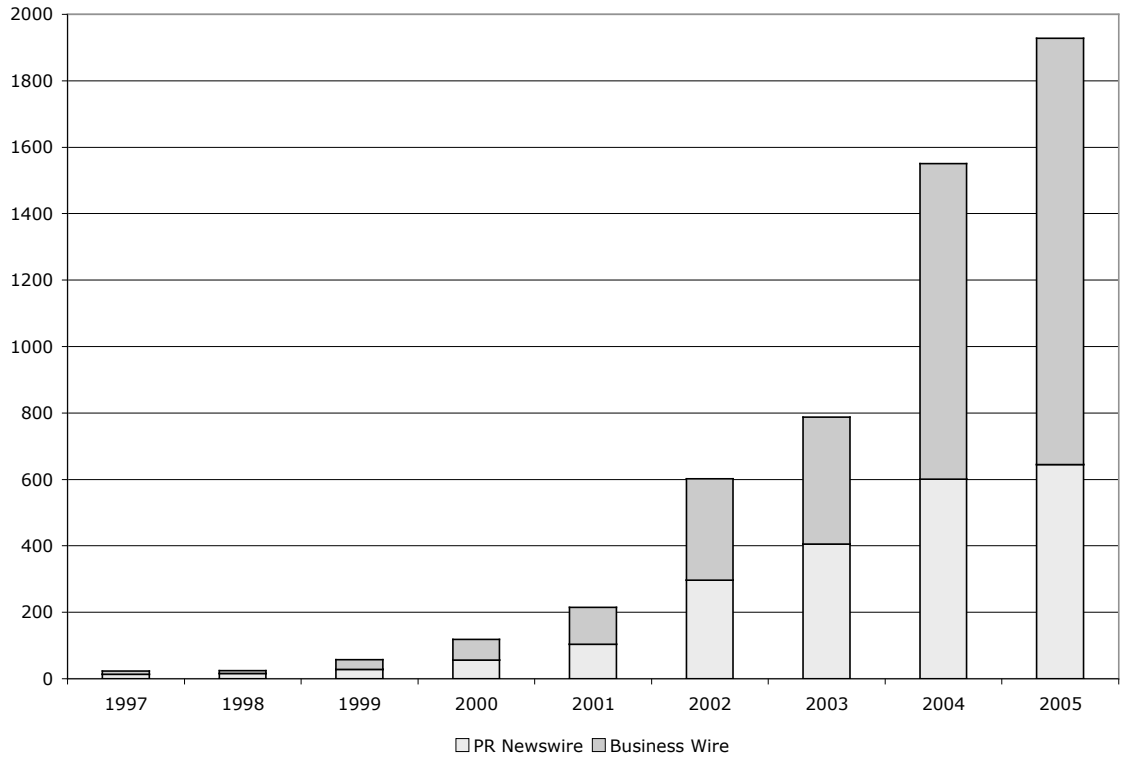
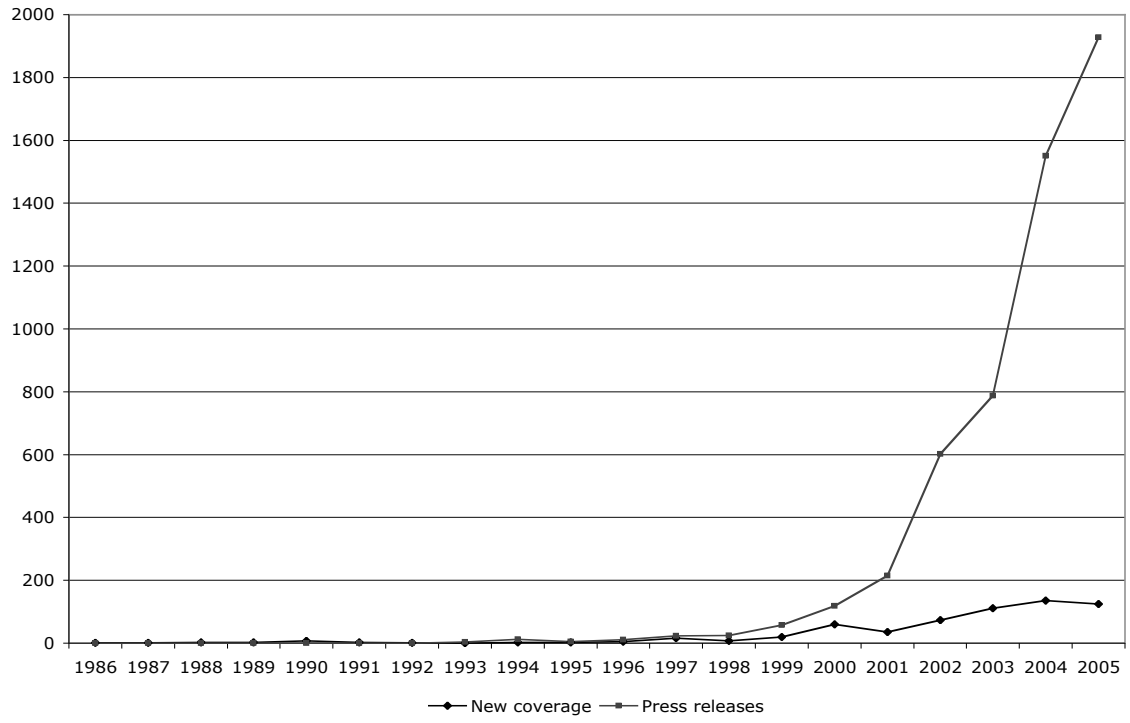


Figure 9 shows that H1 was supported: There was a positive relationship between the number of press releases and the amount of news coverage. Specifically, the growth in news coverage was significantly correlated (.925, $p < 0.01$) with the increase in press releases. News coverage of nanotechnology has grown steadily over the last two decades and firms' desire to communicate their involvement in this new area has grown in sync.

Figure 9. Total number of articles and press releases about nanotechnology, 1986–2005.



Total news articles about nanotechnology mentioned 146 firms, of which 17 were non-diversified firms. H2 was supported: Diversified firms received much more

news coverage than non-diversified firms. News coverage of non-diversified firms comprised only 10% of coverage given to the 30 most mentioned firms (Table 7).

Table 7. Thirty most mentioned firms in news articles about nanotechnology.

Rank	Company	Industry	# of articles
1	SUN	Computers (hardware)	88
2	IBM	Computers (hardware and services)	85
3	Intel	Electronics	55
4	Hewlett-Packard (HP)	Computers (hardware)	52
5	Microsoft	Computers (software)	35
6	General Electric (GE)	Conglomerate	29
7	DuPont	Chemicals	28
8	Sharp	Electronics	27
9	Motorola	Telecommunications	22
10	Nanosys	Electronics	22
11	Lucent	Telecommunications	19
12	Bell Labs (owned by Lucent)	Research	17
13	Merrill Lynch	Financial	17
14	General Motors (GM)	Automotive	14
15	Molecular Electronics	Research	12
16	Lux Capital	Financial	11
17	**Harris & Harris**[1]	**Financial**	**10**
18	Zyvex	Electronics	10
19	JPMorgan	Financial	9
20	NEC	Electronics	9
21	NanoProducts	Chemicals	9
22	AMD	Electronics	8
23	Hitachi	Conglomerate	8
24	**Nanogen**	**Pharmaceuticals**	**8**
25	Philips	Conglomerate	8
26	3M	Conglomerate	6
27	Nanofilm	Chemicals	6
28	**Veeco Instruments**	**Electronics**	**6**
29	Toshiba	Computers (hardware)	6
30	Honeywell	Manufacturing	5

1. Bolded companies represent non-diversified firms on the Merrill Lynch Nanotech Index.

H3 was also supported: Amongst the most mentioned corporations in news coverage, firms in the electronics industry (23%) were more widely covered than firms in other industries, including computers (17%), financial (13%), chemicals

(10%), telecommunications (7%), research (7%), pharmaceuticals (3%), automotive (3%), and manufacturing (3%). Conglomerates received 13% of the coverage.

H4 was not supported: Non-diversified firms were identified fewer times in press releases about nanotechnology than diversified firms (Table 8).

Table 8. Thirty most mentioned firms in press releases about nanotechnology.

Rank	Company	# of press releases
1	IBM	305
2	Intel	221
3	Biophan	209
4	Microsoft	183
5	Hewlett-Packard (HP)	177
6	**FEI**[1]	**163**
7	General Electric (GE)	158
8	Motorola	145
9	Lucent	143
10	**Veeco Instruments**	**135**
11	**Harris & Harris**	**132**
12	**Ultratech**	**129**
13	SUN	118
14	**Nanophase Technologies**	**117**
15	Nanosys	111
16	Zyvex	109
17	Philips	103
18	**Acacia Research–Combimatrix**	**102**
19	DuPont	100
20	Bell Labs (owned by Lucent)	99
21	mPhase	96
22	**Nanogen**	**94**
23	**JMAR Technologies**	**93**
24	**Altair Nanotechnologies**	**91**
25	AMD	87
26	**Biosante Pharmaceuticals**	**82**
27	**Kopin**	**79**
28	Deloitte	76
29	Samsung	69
30	Accelrys	67

1. Bolded companies represent non-diversified firms on the Merrill Lynch Nanotech Index.

Press releases were distributed by 403 companies in the sample. Non-diversified firms comprised 30% of the 20 most mentioned firms (6 out of 20) and 37% of the 30 most mentioned firms (11 out of 30) in these press releases .

With respect to RQ1 firms that executed nanotechnology activities only sometimes identified themselves, or were identified, as doing so (Tables 9 and 10).

Table 9. Top 30 publicly identified nanotechnology companies, in news coverage.

Rank	Company	# of paragraphs
1	IBM	75
2	Nanosys	51
3	SUN	26
4	Hewlett-Packard (HP)	23
5	Intel	20
6	DuPont	19
7	General Electric (GE)	12
8	Merrill Lynch	12
9	**Nanogen**[1]	**11**
10	**Harris & Harris**	**10**
11	Lux Capital	10
12	Nanofilm	10
13	Zyvex	10
14	NEC	9
15	**Veeco Instruments**	**8**
16	Sharp	7
17	Bell Labs (owned by Lucent)	5
18	Nantero	5
19	3M	4
20	AcryMed	4
21	Babolat	4
22	Konarka	4
23	Lux Research	4
24	Molecular Electronics	4
25	Motorola	4
26	NanoOpto	4
27	Lucent	4
28	**Altair Nanotechnologies**	**3**
29	Raytheon	3
30	Hitachi	2

1. Bolded companies represent non-diversified firms on the Merrill Lynch Nanotech Index.

News coverage about nanotechnology revealed that the 30 most mentioned firms in articles about nanotechnology (Table 7) were somewhat likely to be mentioned in the same paragraph as a nanotechnology keyword (Table 9). The list of firms in both tables is 58% identical. That is to say, 22 out of 38 companies can be found in both Table 7 and Table 9. In each case, non-diversified firms are mentioned less than 14% of the time and the bulk of the coverage appears to identify companies that are already well known outside of nanotechnology (e.g. IBM, Intel, GE). It is worth noting that Nanosys, a private company, appears to be prominently identified in news coverage as a firm working with nanotechnology. Nanosys was not included as part of the non-diversified sample of firms because it was not listed in the Merrill Lynch Nanotech Index. The same is true of other companies whose names may infer that they are nanotechnology-focused in their endeavors (e.g. Nanofilm, NanoProducts, NanoOpto).

In press releases about nanotechnology, the 30 most mentioned firms (Table 8) were even less likely to mention their company name in the same paragraph as a nanotechnology keyword (Table 10). Only 20 out of 40 firms can be found in both lists, though more than half of these are non-diversified firms. Table 10 shows that non-diversified firms are much more active in promoting their nanotechnology endeavors in press releases than news coverage would indicate. As demonstrated by the number of press release paragraphs in which non-diversified firms are mentioned in relation to nanotechnology, they are also more likely to frequently associate themselves with nanotechnology in their writings than are diversified firms involved in other undertakings.

Table 10. Top 30 publicly identified nanotechnology companies, in press releases.

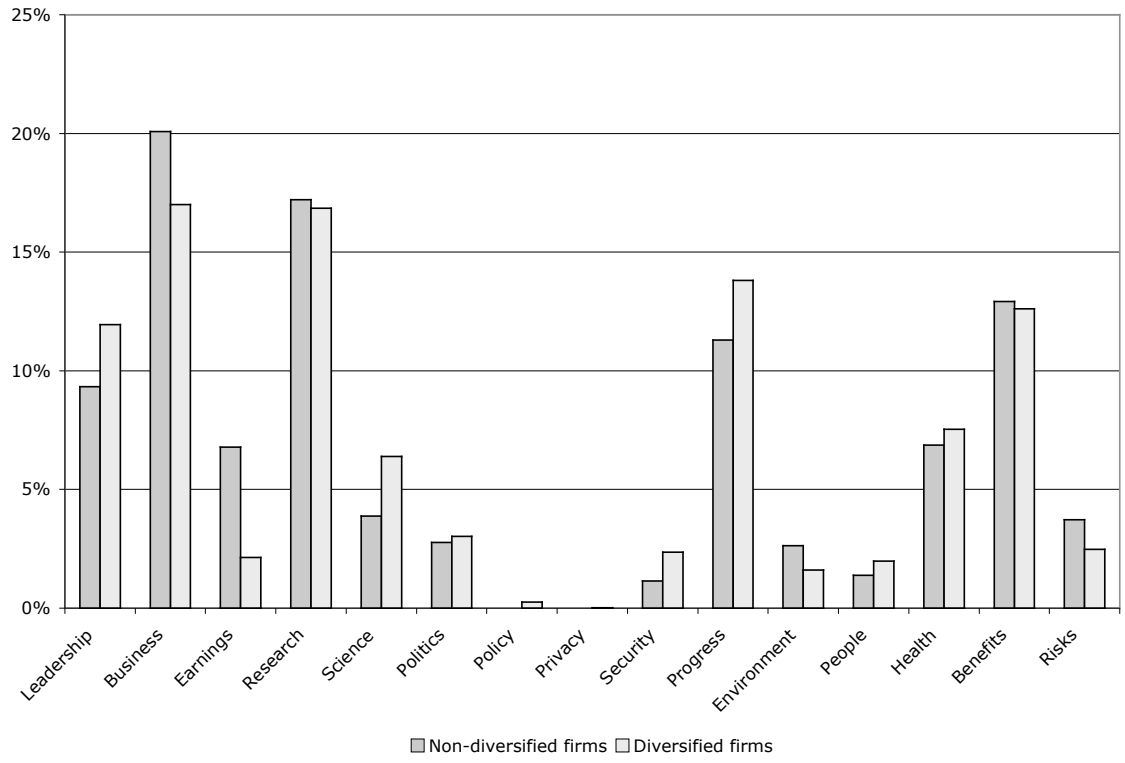
Rank	Company	# of paragraphs
1	Biophan	419
2	**Altair Nanotechnologies**[1]	**311**
3	**Ultratech**	**255**
4	Nanosys	253
5	**Nanophase Technologies**	**239**
6	Zyvex	218
7	**FEI**	**217**
8	mPhase	196
9	IBM	173
10	**Arrowhead Research**	**172**
11	Lux Research	171
12	**Veeco Instruments**	**169**
13	**pSivida**	**134**
14	**Harris & Harris**	**132**
15	**Biosante Pharmaceuticals**	**127**
16	**Tegal**	**122**
17	**Acacia Research–Combimatrix**	**117**
18	**Nanogen**	**110**
19	Accelrys	101
20	Nanodynamics	97
21	**JMAR Technologies**	**96**
22	**Kopin**	**96**
23	NaturalNano	96
24	Lux Capital	85
25	NanoMarkets	85
26	Bioforce	84
27	Bell Labs (owned by Lucent)	80
28	GE	80
29	Intel	80
30	**Lumera**	**78**

1. Bolded companies represent non-diversified firms on the Merrill Lynch Nanotech Index.

RQ2 explored the differences between how non-diversified firms and diversified firms present themselves to the media through their press releases. It did this by identifying, by paragraph, in firms' press releases, the frequency with which specific themes were discussed by firms in relation to nanotechnology. Non-diversified firms accounted for 34% of companies discussing these themes.

Figure 10 shows that nanotechnology firms of both types thematically associated themselves most often with business, research, progress, benefits, and leadership. Business (20% versus 17%) and earnings (7% versus 2%) themes were associated more frequently with non-diversified firms, while leadership (12% versus 9%), science (6% versus 4%), and progress (14% versus 11%) were discussed more often by diversified firms. Other themes (e.g. research, health, benefits) were associated as frequently with one type of firm as with the other.

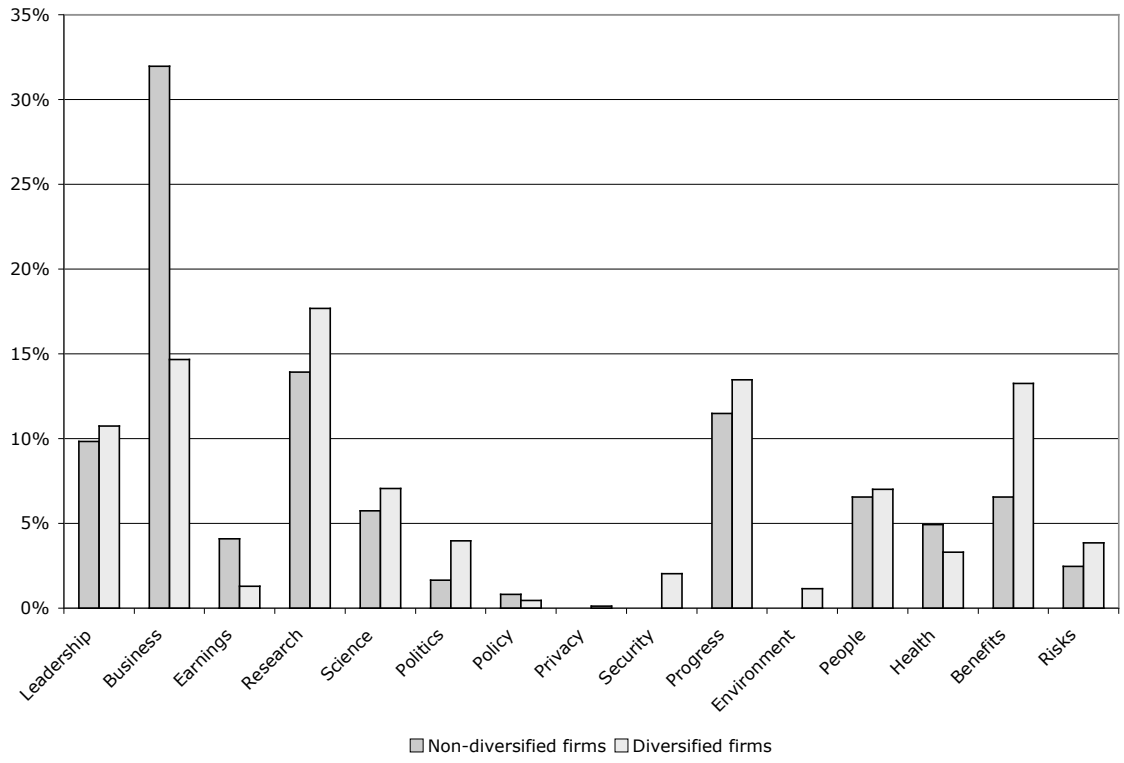
Figure 10. Percent of theme mentions associated with nanotechnology firms in press releases.



H5 was not supported: Both types of nanotechnology firms discussed an equally wide range of themes in their press releases. Policy and privacy themes did emerge exclusively in the press releases of non-diversified firms, but these themes appeared in less than 0.5% of all releases were, therefore, not deemed significant.

RQ3 identified the differences in thematic news coverage of non-diversified firms and diversified companies (Figure 11). Non-diversified firms accounted for only 4% of companies associated with these themes.

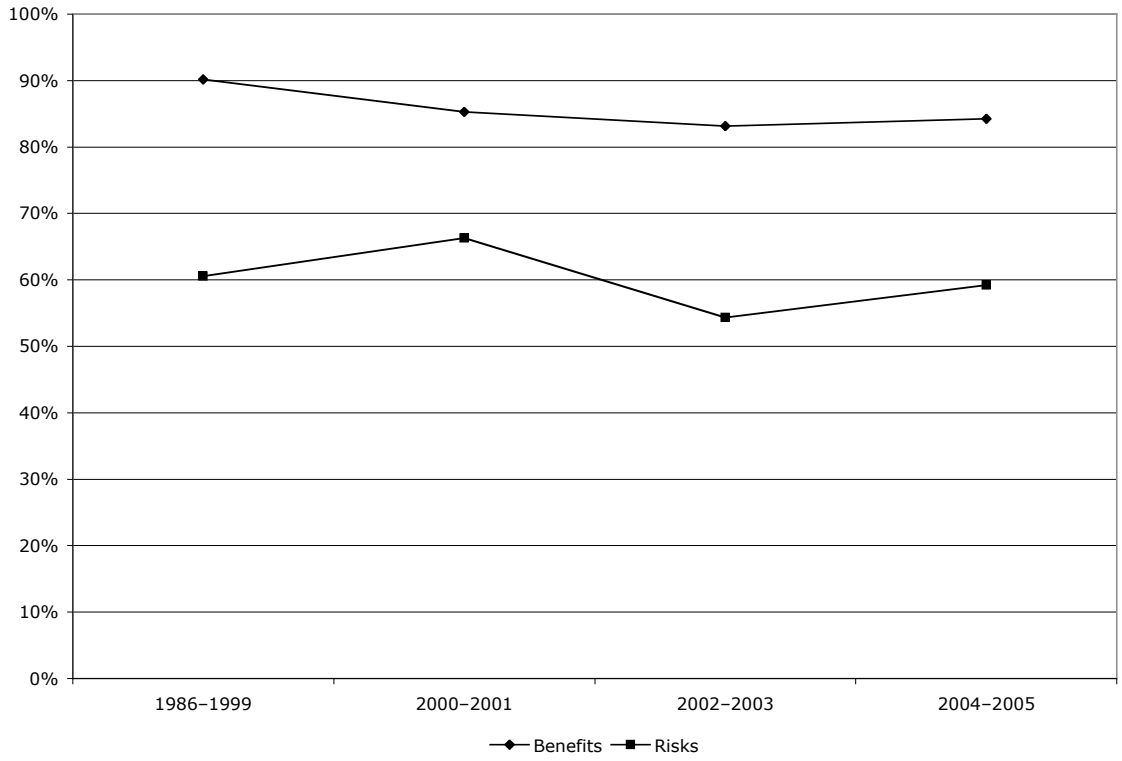
Figure 11. Percent of theme mentions associated with nanotechnology firms in news coverage.



Firms involved in nanotechnology activities were again most strongly associated with business, research, progress, benefits, and leadership. The very few theme mentions linked to non-diversified firms were more strongly associated with business (32% versus 15%) and earnings (4% versus 1%). Non-diversified firms were mentioned more often in relation to the benefits of nanotechnology (13% versus 7%) and research (18% versus 14%).

RQ4 looked at whether news coverage was more focused on the benefits or on the risks of nanotechnology (Figure 12).

Figure 12. Percentage of news stories with benefit and risk assessments about nanotechnology over time.



News coverage of nanotechnology across four time periods (1986–1999, 2000–2001, 2002–2003, 2004–2005) focused more on the benefits of the technology than on the risks. The mean of the coefficient of media favorableness was 0.15 and its standard deviation was 0.22, revealing that news coverage of nanotechnology was consistently only slightly more focused on benefits than risks, year-over-year.

H6 was not supported: news coverage of nanotechnology has not focused more on the risks in recent coverage, with only slight fluctuations in the percentage of risk assessments about nanotechnology over the last two decades. New coverage of nanotechnology has continued to focus on the benefits of the technology, without much change.

RQ5 sought to identify the percentage of news stories that resulted directly from corporate press releases (Table 11). Of the top 30 companies identified in news coverage (Table 9) and press releases (Table 10), a total of 38 companies were mentioned in both news stories and press releases. Of these firms, 30 had news stories written about them that were directly influenced by public relations—whether by press releases or otherwise.

The conversion rate of press releases to news coverage—that is to say the number of press releases that had a direct affect on firms' media coverage in this sample—was 8%. Other more general public relations efforts, such as executive or employee soundbites and corporate profiles or features, affected 24% of news coverage. As such, public relations as a whole influenced 32% of news stories written about the 30 firms in this sample.

Table 11. Conversion of press releases and other public relation endeavors vis-à-vis news stories.

Company	Press releases	News stories	Conversion (PR)	Conversion (Other)	Conversion (Total)
IBM	286	80	21	24	45
Hewlett-Packard (HP)	152	51	0	16	16
DuPont	90	26	0	12	12
Intel	200	52	1	8	9
General Electric (GE)	145	27	0	8	8
Bell Labs (owned by Lucent)	97	17	4	3	7
Lucent	133	18	3	4	7
Nanosys	104	21	1	6	7
Lux Capital	52	11	1	5	6
Merrill Lynch	53	16	2	4	6
Nanofilm	24	6	0	6	6
SUN	111	66	0	6	6
Zyvex	103	9	0	6	6
Motorola	135	22	0	5	5
General Motors (GM)	43	14	0	4	4
Harris & Harris[1]	**129**	**8**	**1**	**3**	**4**
JPMorgan	29	9	0	4	4
AMD	83	7	3	0	3
Microsoft	172	33	0	3	3
3M	44	6	0	2	2
Kopin	**79**	**2**	**1**	**1**	**2**
Nanogen	**92**	**8**	**2**	**0**	**2**
NEC	40	7	0	2	2
Veeco Instruments	**133**	**6**	**1**	**1**	**2**
Acacia Research–Combimatrix	**101**	**1**	**0**	**1**	**1**
Hitachi	54	8	0	1	1
JMAR Technologies	**93**	**1**	**1**	**0**	**1**
Samsung	62	4	1	0	1
Sharp	36	24	0	1	1
Toshiba	26	6	0	1	1
Total	**2,901**	**566**	**43**	**137**	**180**

1. Bolded companies represent non-diversified firms on the Merrill Lynch Nanotech Index.

Chapter 5: Discussion

Press releases represent an actional legitimacy tool with which firms establish corporate actions and policies as useful and responsible and gain support for these endeavors from stakeholders. This investigation sought differences in how diversified firms and non-diversified firms communicate their nanotechnology activities and set the media agenda about nanotechnology..

Of the 420 companies identified in this study, a majority of the firms receiving the most nanotechnology news coverage were either large diversified firms (e.g. SUN, IBM, Intel, GE, DuPont) or non-diversified firms drawn from the Merrill Lynch Nanotech Index (American Stock Exchange, 2006). A comparison of nanotechnology press releases and news coverage shows evidence of Pollock and Rindova's (2003) assertion that some level of legitimacy may be necessary for a firm to be considered newsworthy. While non-diversified firms comprised 37% of the 30 most mentioned firms in press releases, they accounted for only 10% of company mentions in news coverage. In contrast, diversified firms accounted for a majority (90%) of mentions in news coverage about nanotechnology. As a percentage of coverage, non-diversified firms were mentioned almost four times as often in press releases as they were in news coverage. This may suggest that the news media prefer to cover diversified firms because of their increased perceived legitimacy. At the very least, it lends support to Deephouse and Carroll's (2005) hypothesis that organizational size is positively related to news coverage.

Nanotechnology was a particularly salient issue for non-diversified firms as they associated themselves with it in their press releases as often as diversified firms. Of the top 30 organizations that associated themselves most frequently with nanotechnology, half of them were non-diversified firms. These firms accounted for 56% of the Merrill Lynch Nanotech Index. This is particularly significant when considering that the Nanotech Index constituted only 7% of all companies in the sample that issued press releases. While this percentage of association to nanotechnology was not maintained in news coverage, where only 13% of firms most often associated with nanotechnology were non-diversified, non-diversified firms were very active in their efforts to gain cognitive nanotechnology legitimacy through their press releases. Unsurprisingly, diversified firms were overwhelming (87%) associated with nanotechnology in news coverage.

Non-diversified firms can gain cognitive legitimacy by visibly championing and implementing recognized methods, models and processes, which are deemed useful and responsible and which are adhered to by diversified firms (Ahlstrom & Bruton, 2001; Aldrich & Fiol, 1994; Suchman, 1995; Zimmerman & Zeitz, 2002). This includes not only corporate functions but organizational strategies such communication practices and messages. In light of this, it is perhaps not surprising that non-diversified firms and diversified organizations using such similar themes to communicate nanotechnology in their press releases. Both emphasized the business and research aspects of nanotechnology, framed nanotechnology in terms of progress, spoke of its benefits, and highlighted their leadership role in this emerging technology. News coverage of nanotechnology generally paralleled these themes,

but did so with a greater focus on people (7% in news coverage versus 2% in press releases).

In their press releases, non-diversified firms accentuated business (20%) and earnings (7%) themes more frequently than diversified firms. This is in line with research about new ventures and legitimacy: Firms seeking to attain legitimacy must demonstrate that they engage in activities that are considered legitimate (Zimmerman & Zeitz, 2002). In this case, this entails giving evidence of corporate competence to business and financial stakeholders. Comparatively, diversified firms highlighted leadership (12%), science (6%), and progress (14%) themes more often than non-diversified firms. Diversified firms have experience working with innovative technologies and know how to communicate them to the media. The emphasis on leadership and progress might be an indication of this. Staking a leadership position in nanotechnology increases the legitimacy of a firm working in that area, particularly if the perception is endorsed by the media (Zimmerman & Zeitz, 2002). Likewise, focusing on advancements within nanotechnology reflects public expectations of the perceived substantial benefits that could result from this technology (Bainbridge, 2002; Cobb & Macoubrie, 2004; Scheufele & Lewenstein, 2005).

Having identified how firms discuss nanotechnology, future research should study how organizations ordinarily communicate mature technologies or industries. Press releases in this study emphasized themes of business, research, progress, benefits and leadership. It would be of value to know if this combination of themes regularly appears in press releases or is an outcome of communicating emerging

technologies. Likewise, further research into the news coverage of mature and emerging technologies is necessary to verify how it compares to coverage of nanotechnology.

News coverage of nanotechnology was found to focus more on the benefits than on the risks, but not to the same degree discovered by Gorss and Lewenstein (2005) when they examined positive and negative coverage. News coverage of nanotechnology that is focused on its benefits is valuable to both non-diversified and diversified firms. Favorable assessments of nanotechnology reflect positively on firms working with it and act as a form of endorsement for them. In this study, the mean of benefit assessments in news stories was 86% and the mean of risk assessments was 60%. As a general comparison, Gorss and Lewenstein (2005) found a mean of 71% for positive assessments and of 20% for negative assessments.

Using the coefficient of media favorableness (Deephouse, 2000), news coverage was found to have a mean of 0.15 and a standard deviation of 0.22 between 1986 and 2005. In other words, over that period of time, news coverage of nanotechnology was slightly more more focused on benefits than risks year-over-year. Between 2000 and 2005, the mean of the coefficient of media favorableness drops to 0.10, with a standard deviation of 0.03.

Future research into the type of nanotechnology coverage should employ the coefficient of imbalance (Janis & Fadner, 1965), as it provides researchers with a measure suitable for statistical analysis and yields a variable that can be validly compared across studies. Labeled the coefficient of media favorableness by Deephouse (2000), it measures the relative proportion of favorable to unfavorable

assessments in news coverage while controlling for the overall volume of assessments.

Another important subject for future research is the framing by firms and the news media of nanotechnology itself. Nanotechnology is not a new industry, but a technological evolution relevant to many existing disciplines (Milunovich, et al., 2004). A limitation of this thesis is that it did not identify whether nanotechnology was discussed and framed as the sole topic of discourse by firms and the media or as part of some other, broader topic. For instance, electronics have achieved an unparalleled level of miniaturization in recent years and many microchips are now created through the use of nanotechnology. Future studies should establish the extent to which firms and the media highlight the use of nanotechnology or appropriate it into existing technologies and processes. The latter would likely accelerate the legitimization of nanotechnology and of firms working with it, but would do so at the expense of a potent new social dialogue.

Press releases had a direct influence on only 8% of the sampled news stories involving nanotechnology; a far cry from the 25% to 80% influence of press releases on news coverage hypothesized by Cameron et al. (1997). The percentage of influence was even lower (5%) when removing IBM from the sample. Public relations endeavors, however, which included press releases along with other media placement efforts by public relations practitioners, had a much greater effect on the content of news coverage, influencing 32% of the sampled news stories. These efforts still influenced 28% of news stories when excluding IBM from the sample.

News coverage of nanotechnology focused largely on the advancements of diversified firms such as IBM, Hewlett-Packard, and Intel. IBM was most successful at converting nanotechnology-related press releases to news stories, with 7% of their press releases resulting in 26% of their news coverage.

A manual evaluation of press releases and news coverage associated with the firms in Table 10 revealed that diversified firms benefit from unsought for cognitive legitimacy in both corporate communications and news stories. Press releases by non-diversified firms often mentioned diversified firms with whom they were partnering or to whom they were selling technologies. The press releases of diversified firms, on the other hand, only rarely mentioned partnerships or sales and then, almost exclusively when they occurred with other diversified firms. Instead, they more often focused on their own discoveries and achievements. In their press releases, non-diversified firms attempt to gain cognitive legitimacy by associating themselves with diversified firms while diversified firms seek to extend and justify the legitimacy their already posses.

News stories often mentioned diversified firms when highlighting trends such as research in nanotechnology or the post-dotcom layoffs in the technology industry because of diversified firms' reputation as industry leaders. This can work both for and against firms' overall legitimacy. On the one hand, being consistently mentioned in stories about nanotechnological advancements allows IBM to gain ownership over the issue of nanotechnology. On the other hand, being associated with the downturn of the technology industry does not bolster stakeholders' confidence in the corporation. Even without the influence of press releases, news

coverage was much more likely to highlight, profile, or mention diversified firms than it was to refer to non-diversified firms. In most instances, this likely only reinforces diversified firms existing legitimacy.

Limitations and Future Research Directions

There are limitations to this study that provide opportunities for developing future research directions. The analysis of news coverage and press releases was accomplished using VBPro (Miller, 1995), a set of computer programs developed for content analysis of verbatim text, and user-created theme keyword dictionaries. While effective at quickly analyzing large data sets, computer-assisted text analysis does have some demonstrated limitations. Conway (2006) found that human and computer-assisted content analysis yielded two significantly different results when coding newspaper coverage of a political campaign. Specifically, the computer-assisted approach highlighted broad categories of coverage, while human coders identified more nuanced attributes and issues. Subsequent research could compare the analysis generated by this investigation to that of human coders to ensure the validity and reliability of this system.

While this study posits that firms ultimately gain legitimacy by communicating with and receiving coverage from the news media, it does not quantitatively demonstrate this claim. Future studies should investigate the extent to which newer firms' communications help them gain legitimacy through news coverage. In particular, while this study found that non-diversified firms emphasized business-themed press releases, future research should examine which

themes garner the most news coverage, what sorts of corporate communications are most effective at communicating stories to the news media, and to what extent news coverage affects non-diversified firms' stakeholder legitimacy. Alternatively, in the case of non-diversified firms, elite media coverage may not adequately target the stakeholders these firms want to reach. Future studies should explore how and to who non-diversified firms communicate.

A third limitation of this study is that it restricts corporate communication and actional legitimation efforts to press releases. Firms build relationships with stakeholders and achieve legitimacy in various ways and future research should examine some of these other methods (e.g. quarterly reports, discussions with analysts, other communications with stakeholders, partnerships).

This study examined press releases for any mentions of sampled firms instead of focusing solely on press releases that were distributed by the firms themselves. While this was somewhat beneficial in identifying which firms were most often discussed in relation to nanotechnology, it has the obvious drawback of not directly establishing a ratio between firms' press releases and news coverage that emerged as a result of them. Future studies seeking to identify the conversion of press releases to news coverage should limit press releases to only those issued by firms themselves.

The focus on firm mentions in press releases and news coverage presents an additional limitation—it is not possible to determine the significance of mentions using computer-assisted text analysis. For example, a paragraph in a news article lauding IBM's advances in nanotechnology might also mention Intel as a

competitor. With computer-assisted text analysis, this would result in two firm mentions; one for IBM and another for Intel. A human coder, on the other hand, might attribute a mention only to IBM, as Intel is mentioned merely in passing as a competing firm and not for their work with nanotechnology.

This research's analysis of press release conversion is also limited by its sample. While it generally finds that press releases influenced only 8% of news coverage—substantially less than that hypothesized by Cameron (1997) or found by Blyskal and Blyskal (1985) and Sigal (1973)—it also limits the press release and news coverage samples to only those documents with specific firm mentions. A broader and more inclusive analysis of the influence of press releases on news coverage is required to quantitatively link the two as they relate to the coverage of nanotechnology.

Another limitation arises because of the nature of computer-assisted text analysis. The press release and news coverage samples were selected based on keywords and, while there was some manual elimination of articles, it is unlikely that all remaining documents were specifically about nanotechnology. Likewise, computers-assisted text analysis is incapable of subjectively identifying themes such as leadership or business. Instead, keywords must be associated with each theme. Keywords were manually selected by me, categorized into themes, and tested to ensure the accuracy of the keywords. Nevertheless, some words, such as "first" in the leadership theme or "product" in the business theme can vary in meaning, and therefore in theme, based on the context in which they are used. Also, it is possible that I unintentionally excluded relevant theme keywords from the theme

dictionary by . Future studies should devise a manual or computer-assisted method to refine these methodologies.

Lastly, although this study provides a preliminary assessment of how firms use public relations to legitimize their activities with new technologies and set the media agenda, future studies could further investigate the role of public relations and actional legitimation in creating and maintaining corporate legitimacy. Communication is integral in managing legitimacy (Suchman, 1995) and more academic work related to public relations is required in this area.

Chapter 6: Conclusion

This thesis provides an initial examination of how firms created in or moving into an emerging market such as nanotechnology use public relations to legitimize their actions and policies to make them appear useful and responsible to their stakeholders. While past studies have focused largely on news coverage and public perception of emerging markets, this investigation centers on organizations' use of press releases to communicate their activities and set the media agenda about these markets.

This study finds that press releases and news stories about nanotechnology have both increased over time; that fewer than 10% of news stories about nanotechnology are derived from press releases; that nanotechnology firms of both types thematically associate themselves most often with business, research, progress, benefits, and leadership, but that non-diversified firms highlight nanotechnology through business themes more often than diversified firms; that the news media write about diversified firms more frequently than non-diversified firms; and that news coverage of nanotechnology continues to focus more on benefits than on risks.

Press releases and news stories about nanotechnology share a positive relationship. While it certainly cannot be concluded that news coverage about nanotechnology occurs as a result of increased corporate communications, it can be inferred that press releases strongly influenced the presence of the first news stories on the subject. In the absence of existing knowledge about novel technologies or

industries, press releases can help educate journalists about new discoveries and provide them with alternative story ideas for their reporting.

The effectiveness of press releases at obtaining media coverage once a topic is better known is less assured. Figure 9 shows an explosion of press releases about nanotechnology beginning in 2001. As the number of press releases skyrocketed, news coverage about nanotechnology increased at a much more subdued pace. Anecdotal evidence gleaned from discussions with journalists reveals that they believe that corporations pitch too many insignificant stories. The relatively low conversion rate of press releases to news coverage would seem to support this opinion. Only 8% of press releases about nanotechnology in the sample directly influenced news coverage.

In formulating his definition of actional legitimacy, Boyd (2000) posited that public relations is a relevant and important component of legitimacy building. To be considered legitimate, organizations must not only act legitimately, but must establish corporate actions and policies as useful and responsible and gain support for these endeavors from stakeholders through their public relations endeavors. Consequently, legitimacy building is at the core of most public relations activities (Metzler, 2001).

Building on this, corporate communications themselves must be legitimate—that is, useful and responsible—for firms to consistently receive coverage by the news media. Firms not deemed legitimate in their dealings with journalists are less likely to be covered by them. News coverage requires some level of pragmatic legitimacy (Suchman, 1995) and journalists are more likely to cover

stories that reflect positively on themselves or provide some level of interest to their readers. Therefore, firms that habitually communicate messages and information that are not relevant to journalistic interests may receive less coverage than firms that communicate pertinent and timely information.

This study finds that nanotechnology firms of both types thematically associate themselves most often with business, research, progress, benefits, and leadership, but that non-diversified firms highlight business themes more often than diversified firms in their press releases. These findings corroborate previous research that posits that non-diversified firms can gain cognitive legitimacy by visibly championing and implementing recognized methods, models and processes, which are deemed useful and responsible and which are adhered to by diversified firms (Ahlstrom & Bruton, 2001; Aldrich & Fiol, 1994; Suchman, 1995; Zimmerman & Zeitz, 2002). Likewise, news coverage of non-diversified firms focused significantly on business themes, to a much greater extent than it did for diversified firms. This suggests that the news media acts as a legitimator of lesser known firms by highlighting their compliance to accepted business norms.

Comparatively, news coverage of nanotechnology highlighted research themes for diversified firms more often than for non-diversified firms. Discoveries by better known firms in emerging markets might be considered more legitimate, whether because of firm size or research history, and therefore more newsworthy.

Non-diversified firms working with novel technologies or in new industries should visibly communicate legitimizing activities such as business transactions, partnerships with diversified firms, and memberships in recognized associations.

These activities should not be communicated to the mainstream media if they are not relevant to journalists, but can be targeted to trade publications and relevant stakeholders or be documented on corporate Web sites. Non-diversified firms should also differentiate themselves from diversified firms in the rhetoric that they use with the news media. Green (2004) posits that organizations can more quickly develop sustainable support for their endeavors through a three-step rhetorical process: an emotional appeal to initiate support for nanotechnology, a logical appeal to help implement it, and a moral appeal to sustain support for it. Following these steps, a medical-based nanotechnology firm could, for example, highlight nanotechnology's potential medical benefits in combatting terminal diseases, demonstrate that nanotechnology medicines are effective and affordable, and identify the many advances that have occurred using nanotechnology and emphasize its continuing potential. While both diversified and non-diversified firms can use this technique, it might be particularly effective for non-diversified firms since, as shown in Table 10, they associate themselves very saliently with nanotechnology in their press releases.

This investigation also found that diversified firms are written about more frequently than non-diversified firms. This might be a result of any number of factors, including size, familiarity, and legitimacy. In the case of nanotechnology, the relatively small amount of news coverage about the subject might also be a factor. Irrespective of these issues, non-diversified firms seeking mainstream media coverage must have a story to tell. They must demonstrate an advantage—whether economic, scientific, or human—to get coverage. For example, non-diversified

firms, by virtue of working primarily in an emerging market such as nanotechnology and typically being smaller in size than diversified firms, can accentuate their innovation and nimbleness. When communicating nanotechnology, non-diversified firms should also place a greater emphasis on highlighting the human aspects of the technology. Smaller non-diversified corporations can appear less monolithic than larger diversified firms, allowing emotional appeals to be more effective. A product or discovery that is initially linked to an emotional appeal is more likely to get news coverage than one linked to logical or moral appeal (Green, 2004).

Lastly, this thesis finds that news coverage of nanotechnology continues to focus more on its benefits than its risks. This trend is not expected to last, however, as mainstream media often focuses on the controversial aspects of issues (Scheufele & Lewenstein, 2005; Nisbet & Lewenstein, 2002). For now, since new technologies are generally greeted with optimism, firms should use this opportunity to temper expectations about nanotechnology's benefits and risks. Highlighting the potential benefits of a product or technology can generate interest in its future applications, but allowing its risks to go unacknowledged is neither useful nor responsible and can only hurt the legitimacy of a firm in the long run.

Bibliography

Abrahamson, E., & Fombrun, C. J. (1992). Forging the iron cage: Interorganizational networks and the production of macro-culture. *Journal of Management Studies*, *29*, 175–94.

Ahlstrom, D., & Bruton, G. D. (2001). Learning from successful local private firms in China: Establishing legitimacy. *Academy of Management Executive*, *15*(4), 72–83.

Aldrich, H. E., & Fiol, C. M. (1994). Fools rush in? The institutional context of industry creation. *Academy of Management Review*, *19*, 645–70.

American Stock Exchange. (2006, February 23). *Merrill Lynch Nanotech Index*. Retrieved February 23, 2006, from http://www.amex.com/?href=/othProd/prodInf/OpPiIndComp.jsp?Product_Symbol=NNZ

Anderson, A., Allan, S., Petersen, A., & Wilkinson, C. (2005). The framing of nanotechnologies in the British newspaper press. *Science Communication*, *27*(2), 200–20.

Bainbridge, W. S. (2002). Public attitudes toward nanotechnology. *Journal of Nanoparticle Research*, *4*, 561–70.

Benson, J. A. (1998). Crisis revisited: An analysis of strategies used by Tylenol in the second tampering episode. *Central States Speech Journal*, *39*(1), 49–66.

Berger, B. K. (2001). Private issues and public policy: Locating the corporate agenda within agenda setting theory. *Journal of Public Relations Research*, *13*(2), 91–126.

Blyskal, J., & Blyskal, M. (1985). *PR: How the public relations industry writes the news*. New York: William Morrow.

Boyd, J. (2000). Actional legitimation: No crisis necessary. *Journal of Public Relations Research*, *12*(4), 341–53.

Brummer, J. J. (1991). *Corporate responsibility and legitimacy: An interdisciplinary analysis*. New York: Greenwood.

Burke, D. (2003, March 12). This will be like no other debate. *Times Higher Education Supplement*, p. 13.

Cameron, G. T., Sallot, L. M., & Curtin, P. A. (1997). Public relations and the production of news: A critical review and a theoretical framework. In B. R. Burleson (Ed.), *Communication Yearbook*. (Vol. 20, pp. 111–55). Newbury Park, CA: Sage.

Carroll, C. E., & McCombs, M. (2003). Agenda-setting effects of business news on the public's images and opinions about major corporations. *Corporate Reputation Review*, *6*(1), 36–46.

Christen, C. T. (2005). The restructuring and reengineering of AT&T: Analysis of a public relations crisis using organizational theory. *Public Relations Review*, *31*(2), 239–51.

Cobb, M. D., & Macoubrie, J. (2004). Public perceptions about nanotechnology: Risks, benefits and trust. *Journal of Nanoparticle Research*, *6*, 395–405.

Conway, M. (2006). The subjective precision of computers: A methodological comparison with human coding in content analysis. *Journalism and Mass Communication Quarterly*, *83*(1), 186–2000.

Coombs, W. T. (1992). The failure of the Task Force on Food Assistance: A case study of the role of legitimacy in issue management. *Journal of Public Relations Research*, *4*(2), 101–22.

Curtin, P. A. (1999). Reevaluating public relations information subsidies: Market driven journalism and agenda-building theory and practice. *Journal of Public Relations Research*, *11*(1), 53–90.

Curtin, P. A., & Rhodenbaugh, E. (2001). Building the news media agenda on the environment: A comparison of public relations and journalistic sources. *Public Relations Review*, *27*(2), 179–95.

Deephouse, D. L. (2000). Media reputation as a strategic resource: An integration of mass communication and resource-based theories. *Journal of Management*, *26*(6), 1091–112.

Deephouse, D. L., & Carroll, C. E. (2005, November). *What news is fit to print? A framework explaining the production of news about organizations* (Working paper). University of Alberta.

Deephouse, D. L., & Carter, S. M. (2005). An examination of differences between organizational legitimacy and organizational reputation. *Journal of Management Studies*, *42*(2), 329–60.

Dowling, J., & Pfeffer, J. (1975). Organizational legitimacy: Social values and organizational behavior. *The Pacific Sociological Review*, *18*(1), 122–36.

Editor & Publisher. (2003, September 30). *Top one hundred daily newspapers in the United States according to circulation*. Retrieved February 16, 2006, from http://www.editorandpublisher.com/eandp/images/pdf/Top%20100%20Daily.pdf

Einsiedel, E. F., & Goldenberg, L. (2004). Dwarfing the social? Nanotechnology lessons from the biotechnology front. *Bulletin of Science, Technology & Society*, *24*(1), 28–33.

Elsbach, K. D. (1994). Managing organizational legitimacy in the California cattle industry: The construction and effectiveness of verbal accounts. *Administrative Science Quarterly*, *39*(1), 57–88.

McKean, E. (Ed.). (2001). *New Oxford American Dictionary*. (2 ed.). USA: Oxford University Press.

False positive. (2006, February 19). Retrieved March 19, 2006, from the Wikipedia Web site: http://en.wikipedia.org/wiki/False_positive

Fombrun, C. J., & Shanley, M. (1990). What's in a name? Reputation building and corporate strategy. *Academy of Management Journal*, *33*(2), 233–58.

Friedman, S. M., Dunwoody, S., & Rogers, C. L. (Eds.). (1999). *Communicating uncertainty: Media coverage of new and controversial science*. Mahwah, NJ: Lawrence Erlbaum Associates.

Gandy, O. H., Jr. (1982). *Beyond agenda setting: Information subsidies and public policy.* Norwood, NJ: Ablex Publishing.

Gaskell, G., Eyck, T. T., Jackson, J., & Veltri, G. (2004). Public attitudes to nanotechnology in Europe and the United States. *Nature Materials*, *3*(8), 496.

Gitlin, T. (1980). *The whole world is watching: Mass media in the making and unmaking of the new left.* Berkeley: University of California Press.

Golan, G., & Wanta, W. (2001). Second-level agenda setting in the New Hampshire primary: A comparison of coverage in three newspapers and public perceptions of candidates. *Journalism and Mass Communication Quarterly*, *78*(2), 247–59.

Gorss, J. B., & Lewenstein, B. V. (2005, May 27). *The salience of small: Nanotechnology coverage in the American press, 1986-2004*. Paper presented at the International Communication Association, New York, NY.

Green, S. E. (2004). A rhetorical theory of diffusion. *Academy of Management Review*, *29*(4), 653–69.

Grunig, J. E. (1993). Implications of public relations for other domains of communication. *Journal of Communication*, *43*(3), 164–73.

Hearit, K. M. (1994). Apologies and public-relations crises at Chrysler, Toshiba, and Volvo. *Public Relations Review*, *20*(2), 113–25.

Hearit, K. M. (1995aa). From "We didn't do it" to "It's not our fault": The use of apologia in public relations crises. In W. N. Elwood (Ed.), *Public Relations Inquiry as Rhetorical Criticism*. (pp. 117–31). Westport, CT: Praeger Publishers.

Hearit, K. M. (1995bb). "Mistakes were made": Organizations, apologia, and crises of social legitimacy. *Communication Studies*, *46*(1–2), 1–17.

Heath, R. L. (1997). *Strategic issues management: Organizations and public policy challenges*. Thousand Oaks, CA: Sage.

Heimer, C. A. (2001). Solving the problem of trust. In K. S. Cook (Ed.), *Trust in society*. (pp. 55–81). New York: Russell Sage Foundation.

Ice, R. (1991). Corporate publics and rhetorical strategies: The case of Union Carbide's Bhopal crisis. *Management Communication Quarterly*, *4*(3), 341–62.

Janis, I. L., & Fadner, R. H. (1965). The coefficient of imbalance. In H. D. Lasswell, N. Leites, & Associates (Eds.), *Language of politics: Studies in quantitative semantics*. (pp. 153–69). Cambridge, MA: MIT Press.

Kennedy, M. T. (2003). The earliest moments of new niches: Firms, the media and collective agreements. *Dissertation Abstracts International*, *65* (01), 308A. (UMI No. 3118561)

Kosicki, G. M. (1993). Problems and opportunities in agenda-setting research. *Journal of Communication*, *43*(2), 100–27.

McCombs, M., Llamas, J. P., Lopez-Escobar, E., & Rey, F. (1997). Candidate images in Spanish elections: Second-level agenda-setting effects. *Journalism and Mass Communication Quarterly*, *74*(4), 703–17.

McCombs, M., & Reynolds, A. (2002). News influence on our pictures of the world. In J. Bryant, & D. Zillmann (Eds.), *Media effects*. (2nd ed., pp. 1–16). Mahwah, NJ: Lawrence Erlbaum Associates.

McInerney, C., Bird, N., & Nucci, M. (2004). The flow of scientific knowledge from lab to the lay public: The case of genetically modified food. *Science Communication*, *26*(1), 44–74.

Mehta, M. D. (2004). From biotechnology to nanotechnology: What can we learn from earlier technologies? *Bulletin of Science, Technology & Society*, *24*(1), 34–39.

Meijer, M.-M., & Kleinnijenhuis, J. (2006). The effects of issue news on corporate reputation: Applying the theories of agenda setting and issue ownership in the field of business communication. *Journal of Communication*, *56*(4), 543–59.

Metzler, M. S. (2001). The centrality of organizational legitimacy to public relations practice. In R. L. Heath (Ed.), *Handbook of Public Relations*. (pp. 321–33). Thousand Oaks, CA: Sage.

Miller, M. M. (1995). VBPro: A program for analyzing verbatim text [Computer software and manual]. Retrieved March 1, 2006, from http://www.mmmiller.com/vbpro/vbpro.html

Milunovich, S., Roy, J. M. A., & Fan, Z.-H. (2004, April 16). *Merrill Lynch Nanotech Index*. Retrieved February 19, 2006, from the Merrill Lynch Web site: http://www.ml.com/media/14504.pdf

Moore's law. (2006, March 10). Retrieved March 15, 2006, from the Wikipedia Web site: http://en.wikipedia.org/wiki/Moore's_law

Nanovip.com. (n.d.). *Nanotechnology International/USA*. Retrieved March 1, 2006, from http://www.nanovip.com/directory/International/Usa/index.php

National Nanotechnology Initiative. (n.d.). *Why fund nanotechnology?* Retrieved March 15, 2006, from www.nano.gov/html/facts/faqs.html

Nelkin, D. (1995). *Selling science: How the press covers science and technology* (2 ed.). New York: Freeman.

Nisbet, M. C., Brossard, D., & Kroepsch, A. (2003). Framing science: The stem cell controversy in an age of press/politics. *The Harvard International Journal of Press/Politics*, *8*(2), 36–70.

Nisbet, M. C., & Lewenstein, B. V. (2002). Biotechnology and the American media: The policy process and the elite press, 1970 to 1999. *Science Communication*, *23*(4), 359–91.

Pfeffer, J., & Salancik, G. R. (1978). *The external control of organizations: A resource dependence perspective.* New York: Harper & Row.

Pollock, T. G., & Rindova, V. (2003). Media legitimation effects in the market for initial public offerings. *Academy of Management Journal*, *46*(5), 631–42.

Roco, M. C., & Bainbridge, W. S. (Eds.). (2001). *Societal implications of nanoscience and nanotechnology.* Arlington, VA: National Science Foundation.

Roco, M. C., & Bainbridge, W. S. (2005). Societal implications of nanoscience and nanotechnology: Maximizing human benefit. *Journal of Nanoparticle Research*, *7*, 1–13.

Rogers, E. M., Dearing, J. W., & Bregman, D. (1993). The anatomy of agenda setting research. *Journal of Communication*, *43*(2), 68–84.

Roper, J., & Toledano, M. (2005). Taking in the view from the edge: Issues management recontextualized. *Public Relations Review*, *31*(4), 479–85.

Sachsman, D. B. (1973). Public relations influence on coverage of environments. *Journalism Quarterly*, *53*(1), 54–60.

Scheufele, D. A., & Lewenstein, B. V. (2005). The public and nanotechnology: How citizens make sense of emerging technologies. *Journal of Nanoparticle Research*, *7*, 659–67.

Scott, W. R. (2000). *Institutions and organizations* (2nd ed.). Thousand Oaks, CA: Sage.

Siegrist, M. (2000). The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk Analysis*, *20*(2), 195–204.

Sigal, L. V. (1973). *Reporters and officials: The organization and politics of newsmaking.* Lexington, MA: D.C. Heath.

Stephens, L. F. (2004, March 4–7). *News narratives about nano: How journalists and the news media are framing nanoscience and nanotechnology initiatives and issues*. Paper presented at the Imaging and Imagining NanoScience and Engineering, Columbia, SC.

Stephens, L. F. (2005). News narratives about nano S&T in major U.S. and non-U.S. newspapers. *Science Communication*, *27*(2), 175–99.

Stillman, P. G. (1974). The concept of legitimacy. *Polity*, *7*(1), 32–56.

Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of Management Review*, *20*(3), 571–610.

Ulrich, P. (1995). Business in the nineties: Facing public interest. In P. Ulrich, & C. Sarasin (Eds.), *Facing public interest: The ethical challenge to business policy and corporate communications*. (pp. 1–8). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Weiss, C. H. (1974). What America's leaders read. *Public Opinion Quarterly*, *38*(1), 1–22.

Williams, D., & Treadaway, G. (1992). Exxon and the Valdez accident: A failure in crisis communication. *Communication Studies*, *43*(1), 56–64.

Witt, W. (1974). The environmental reporter on U.S. daily newspapers. *Journalism Quarterly*, *51*(4), 697–704.

Zehr, S. C. (1999). Scientists' representations of uncertainty. In S. M. Friedman, S. Dunwoody, & C. L. Rogers (Eds.), *Communicating uncertainty: Media coverage of new and controversial science.* Mahwah, NJ: Lawrence Erlbaum Associates.

Zimmerman, M. A., & Zeitz, G. J. (2002). Beyond survival: Achieving new venture growth by building legitimacy. *Academy of Management Review*, *27*(3), 414–31.

Zuckerman, E. W. (2000). Focusing the corporate product: Securities analysts and de-diversification. *Administrative Science Quarterly*, *45*(3), 591–619.

Zyglidopoulos, S. C. (2003). The issue life-cycle: Implications for social performance and organizational legitimacy. *Corporate Reputation Review*, *6*(1), 70–81.

Appendix A

Table 12. Company dictionary.

Company name (variations)	
3Dm	Lux Capital
3M	Lux Research
3i	Luxtera
4Wave	MFIC
ABP	MTI
ACLARA	MTR
ALD NanoSolutions	MTS Systems
AMCOL	MagiQ Technologies
ANP	Magma Design Automation
ANSYS	Materia
AP Materials	Matrix Semiconductor
ARC Outdoors	Matsushita
ARCH	McGovern Capital
ASML	Merrill Lynch
AVS	MetaMateria Partners
Abraxis	Metallicum
Acacia Research-CombiMatrix	MicroPowder
Accelrys	Microfabrica
AcryMed	Micron Tech
Acusphere	Micronics
Adept Technology	Microsoft
Advance Nanotech	Minus K Technology
AdvanceTEC	Mitsubishi
Advanced Diamond	Molecular Electronics
Advanced Magnetics	Molecular Foundry
Advanced Micro Devices (AMD, A.M.D.)	Molecular Imaging
Advion	Molecular Imprints
Aerogel Composite	Molecular Nanosystems
Affymetrix	Moore Nanotechnology Systems
Agilent	Mosel Vitelic
Akustica	Motorola
Alameda	MysticMD
Albany NanoTech	NEC
Alnis	NEI
Altair	NUCRYST
Alysium	NVE
Amersham	Nanergy
Analytiq	NanoBio
AngstroVision	NanoCure
Angstrom	NanoEner
ApNano	NanoGram
Apex	NanoHorizons

Table 12. Continued.

Company name (variations)	
Aphios	NanoInk
Apogee	NanoKinetix
Apollo Diamond	NanoLab
Applied Biosystems	NanoLogix
Applied Films	NanoMarkets
Applied Materials	NanoMed Pharmaceuticals
Applied MicroStructures	NanoNexus
Applied NanoWorks	NanoOpto
Applied Nanotechnologies	NanoSIG
Applied Sciences	NanoSense
Applied Thin Films	NanoString
Ardesta	NanoVance
Argonide	NanoWave
Ariel	Nanobac
Arrowhead	Nanocerox
Arryx	Nanochem
Ascend	Nanocoolers
Aspen Aerogels	Nanocor
Asylum	Nanocrystal Imaging
Atlas Venture	Nanocrystal Technology
Atmel	Nanocs
AtomWorks	Nanodisc
Authentix	Nanodynamics
Aviza	Nanofilm
Avogadro	Nanogen
Axiom Capital Management	Nanomat
Babolat	Nanometrics
Battery Ventures	Nanomix
Bayer	Nanonex
Beckman Coulter	Nanophase
Bell Labs	Nanopics
Beyond Skin Science	Nanoplex
BioCrystal	Nanopoint
BioDelivery	Nanorex
BioPixels	Nanoscience Technologies
BioTrove	Nanosolar
Bioforce	Nanospectra
Biophan	Nanostellar
Biosante	Nanostream
Brewer Science	Nanosyn
Burlington Industries	Nanosys
Burrill & Company	Nanova
C Sixty	Nanoventions
CALMEC	Nanoverse
Cabot	Nantero
Cadence	NaturalNano

Table 12. Continued.

Company name (variations)	
Calient	NeoPhotonics
Caliper	New River Kinematics
Cambrios	New Scale Technologies
Carbon Nanotechnologies	Newbridge Securities
CardioMEMS	Nextreme Thermal Solutions
Catalytic	Nion
Cavendish	Noble Polymers
Cell Robotics International	Nomadics
Cepheid	Norsam Technologies
Cetek	Novavax
ChevronTexaco	Olympus
Cima NanoTech	Optical Components
CogniTek	Optiva
Colossal Storage	Orchid BioSciences
Competitive Technologies	Orthovita
Cookson Electronics	Ovonyx
Copernicus Therapeutics	Owlstone Nanotech
Coventor	PSI-TEC
Cronus Capital Markets	Pacific Fuel Cell
Crystalplex	Pacific Nanotechnology
Cyclics	PharmaSeq
Cypress	Pharmacopeia
Cyrano Sciences	Philips
CytImmune Sciences	Photo-Optical
Cytoplex Biosciences	Physical Sciences
DaimlerChrysler	Pillsbury Winthrop
Dais Analytic	Platypus Technologies
DayStar	Polaris Venture Partners
Deloitte	PolyFuel
Dendritic Nanotechnologies	Polytec
Dimatix	PowerMetal
Discera	Powerchip
Discovery Technology	Precision Optics
Dow Corning	Princeton Instruments
Draper Triangle Ventures	Protiveris
Drexel	Punk Ziegel
Dupont	PureTech Ventures
E Ink	Pyrograf Products
Ecology Coatings	Quantum Dot
Eikos	Quantum Insight
Eksigent Technologies	QuantumSphere
Emcore	RAVE
Emergency Filtration Products	RTP
Ener1 Group	Radiation Shield Technologies
EnerTech Capital	Raytheon
Engelhard	Rolltronics

Table 12. Continued.

Company name (variations)	
EnviroSystems	SDForum
Etec	SENSE Holdings
Evident Technologies	SRI International
Evolved Nanomaterial Sciences	STMicroelectronics
Excellin Life Sciences	SUN
FEI	Sabety
Fischione Instruments	Samsung
Five Star	SanDisk
Flagship Ventures	Savant
Flamel	Schrodinger
Fluidigm	Seagate
Freescale Semiconductor	Seki Technotron
Freitas	Sequence Design
Fujitsu	Sevin Rosen Funds
General Electric (GE, G.E.)	Sharp
GEMZ	SiGNa Chemistry
Garage Technology	Sigma-Aldrich
GeneFluidics	Silicon Genesis
GeneOhm	SkyePharma
Genencor	SmalTec
General Motors (GM, G.M.)	SmallTech
Genus	Solaris Nanosciences
Global Crown Capital	SolidWorks
Greater Zurich Area	Solubest
Hewlett-Packard (Hewlett Packard, HP, H.P.)	Sono-Tek
Harris & Harris	SouthWest NanoTechnologies
Headwaters	Southern Clay Products
HelioVolt	Spherics
Hitachi	Spire
Honeywell	Starfire Systems
Hybrid Plastics	Strategic Synergy Group
Hynix	Surface Logix
Hypercube	SurgRx
Hyperion	Symyx
Hysitron	Synopsys
International Business Machines (IBM, I.B.M.)	Syrrx
Illuminex	Taiwan Semiconductor
ImaRx	Tecan
Imago	Technanogy
Immunicon	TechnoMed Strategic Partners
Improvita	Tegal
In-Q-Tel	Texas Instruments
InMat	The Aurora Funds
Industrial NanoTech	The Livingston Group
Infineon	The Maple Fund
Inframat	The NanoSteel Company

Table 12. Continued.

Company name (variations)	
InnovaLight	ThinkEquity Partners
Innovation Works	Three-Five
Insert Therapeutics	Toshiba
Integrated Nanosystems	Total Fab Solutions
Intel	Transfer Devices
Intematix	Triton Systems
Interface Sciences	U.S. Genomics
Introgen	US Global Nanospace
Invitrogen	Ultratech
Isonics	Universal Display
J Giordano Securities	Veeco
J.P. Morgan (JP Morgan, JPMorgan)	Venrock Associates
JMAR Technologies	Westaim
Jackson Walker	Winbond
Kainos Energy	XEI Scientific
Keithley Instruments	Xintek
Kereos	Xradia
Kionix	ZettaCore
Kodak	Ziptronix
Komag	Zyvex
Konarka	cDream
Kopin	eSpin
Kovio	engeneOS
L'Oreal	i-STAT
Larta	iMEDD
LiftPort Group	mPhase
Liquidia Technologies	nPoint
Lucent	nanoTEN
Lumera	pSivida
Luna	vFinance