2003

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A Research Monograph of the

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October 2003

No. PICRM-2003-03

R·I·T Printing Industry Center

An Alfred P. Sloan Foundation Center

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With Thanks

The research agenda of the Printing Industry Center at RIT and the publication of research findings are supported by the following organizations:

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Abstract

In the 1990s, there was an explosion of experimental technical assistance programs at the national, state and local levels. These programs were designed to promote pollution prevention and compliance with environmental regulations. Encouraging the adoption of environmentally friendly technologies in small firms, however, has been difficult. The goals of this paper are to examine how environmental programs for small businesses in the U.S. have evolved over the past two decades and to begin to explore the effectiveness of these programs from the perspective of small companies.

The authors would like to thank the participants in this research project, as well as the Printing Industry Center at the Rochester Institute of Technology for supporting this work.

Introduction

Developing programs to promote the adoption of environmentally friendly technologies in small firms is particularly difficult (United States Government Accounting Office [US GAO], 2001). Several researchers (Crain & Hopkins, 2001; Dean, Brown, & Stango, 2000; Yeager, 1987) have found that smaller firms tend to face greater challenges in meeting and exceeding regulatory requirements. It is difficult to get the appropriate information and knowledge to these smaller firms and to enable them to implement solutions. Numerous experiments aimed at improving environmental outcomes in small firms with and without regulation are currently being conducted at the federal, state, and local levels of government.

Since the mid-1980s, the U.S. Environmental Protection Agency and state level environmental agencies have relied on a variety of voluntary programs emphasizing technical information and direct assistance to encourage pollution prevention technology diffusion in small companies. Government agencies, in the hopes of attracting more firms, are constantly evolving these programs to make them more appealing to small. These experiments may be forming the foundation of the next wave of environmental policy. Evidence of the success of these programs, however, tends to be anecdotal, which makes it difficult for researchers and policymakers to evaluate their benefits and to develop organizational models of successful programs.

The goals of this paper are to examine how environmental programs for small businesses in the U.S. have evolved over the past two decades and to begin to explore the influence of technical assistance programs on the environmental choices of small companies. Insights are drawn from the printing industry, a sector where small firms predominate. After a brief overview of the U.S. printing industry, the historic evolution of government involvement with small printers is reviewed. Survey, interview, and secondary source data is then examined to assess the effectiveness of these programs. Finally, the new phase of government experimentation and involvement that is emerging in response to the challenges faced by the first generation of voluntary assistance programs is discussed.

THE PRINTING INDUSTRY

The printing industry is comprised of approximately 62,355 firms, with sales of approximately $210 billion annually.[1] This industry is a significant contributor to the overall U.S. economy. Historically, this sector has also been a fair contributor to the environmental impact created by U.S. manufacturing industries. According to the 2000 Toxics Release Inventory (TRI), the 202 printing firms that reported under this program released 19 million pounds of toxic chemicals to the environment in one year.[2] This number includes only those 202 (out of over 60,000) firms large enough to require TRI reporting. The environmental impact is no doubt significantly larger when all firms are considered.

One of the primary motivators for choosing the printing industry as the focus of this study was the prevalence of these small- and medium-sized firms. Pressure from both government and society to regulate environmental impact has been focused on larger firms. Similarly, research on environmental management, regulation, and performance has primarily focused on larger firms. This is due in part to TRI emissions, which is the most popular measure of performance used in this type of research. It is, by its nature, exclusionary to small firms.

Introduction

Numerous regulatory and non-regulatory initiatives have sought to propel the printing industry toward better environmental performance with regard to air emissions, through either enhanced pollution control or adoption of greener manufacturing technologies and practices. These programs represent a range of strategies for affecting environmental behavior. These efforts undoubtedly represent a significant investment of both public and private resources and are worthy of close examination to better understand whether and how these programs are having an impact on the environmental performance of printing firms.

METHOD

Survey

The quantitative data comes from a survey panel of 663 printers who volunteered to participate in a series of online surveys administered by the Printing Industry Center at RIT.[3] Participants were offered incentives, such as early access to results, written material, and a free online seminar. Out of the 663 printing firms on the panel, 128 participated in this particular survey. Respondents were asked to report their knowledge of and perceived usefulness of a number of industry and government technical assistance programs.

Qualitative Data Collection

In addition to the survey data, several interviews were conducted with printers and program managers of a variety of technical assistance programs. In order to attain more detailed information about the day-to-day management of environmental waste at a printing shop, one in-depth case study was done with a small printer. These interviews served to give more information on the goals and practices of the technical assistance programs and the printer's perceptions of these programs. Interviews were either taped and transcribed, or notes were typed up immediately after the interview in order to retain as much as the information as possible.

[1]1997 estimates. U.S. Census Bureau, http://www.census.gov

[2]http://www.epa.gov/tri/tridata/tri00/index.html

[3]The panel was created from a sample of 10,500 printers and packagers selected from the Dunn and Bradstreet database. The sample was chosen to represent the variety of printing technologies and firms size. All firms with 20 or more employees are included in the sample (approx. 5,000). In addition, 50% of firms with 10 to19 employees, and 15% of firms with 9 or fewer employees were randomly selected.

The Evolution of Government Involvement

SMALL FIRMS IN THE FRAY

The ways in which the government has managed the environmental impacts of small printers has evolved over time. Prior to the 1980s, small printers were regulated primarily through operating permits, but environmental agencies were lenient in their regulation of these smaller firms.

There were several basic assumptions that drove this policy. First, perhaps because they were less visible, small sources seemed to have a relatively insignificant impact on the environment compared to larger companies (Schaper, 2002).

Second, and perhaps more importantly, many argued that regulation was too taxing for small businesses, as they did do not have the financial or technical means to comply with regulation. There was a concern that requiring complex paperwork and pollution control equipment for small firms would drive small companies out of business. There is substantial research that supports this view. Small firms, for example, often lack risk-bearing capital, technically qualified personnel, or adequately educated and well informed management (Schmidt, 1990). Because of these disadvantages, research suggests that smaller firms have greater challenges in meeting and exceeding regulatory requirements, especially for changes that require the implementation of costly new technology (Crain & Hopkins, 2001; Dean et al., 2000; Yeager, 1987). Dean et al. argue that there is an overall higher unit pollution abatement cost associated with small firms. They suggest that compliance asymmetries occur when regulations are equally applied and enforced across small and large firms. In this situation, asymmetries result from differences in compliance costs per unit output between small and large firms. Moreover, the larger firms have an advantage in defending themselves due to greater legal resources.

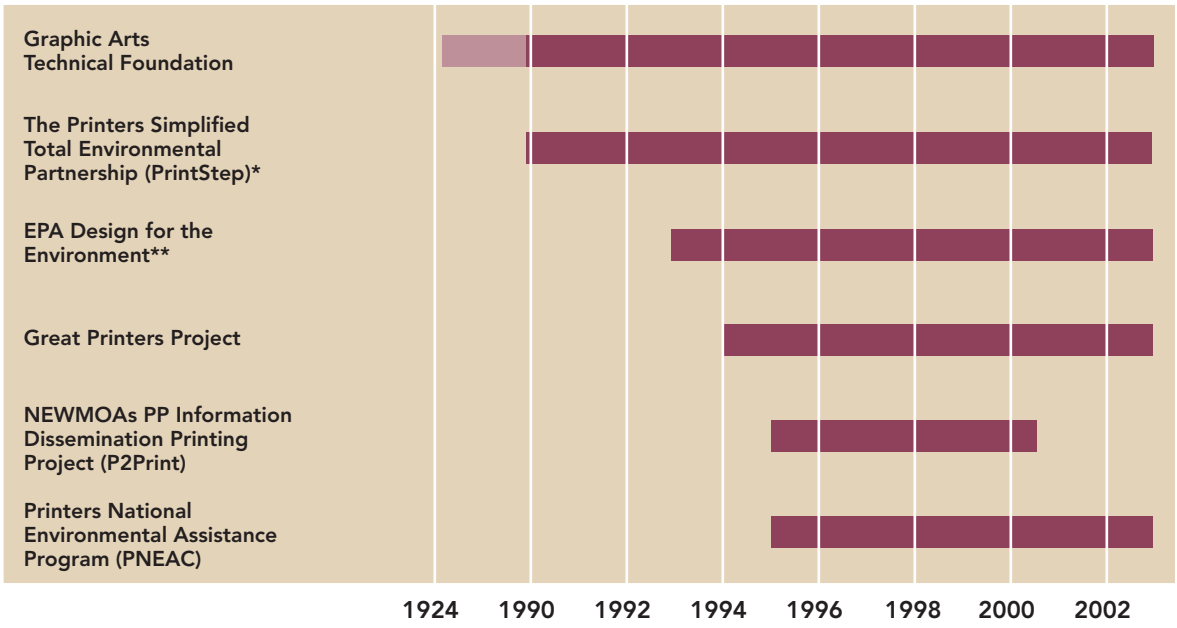
The third assumption was that regulation of small firms was not only too costly for firms, but also the government. The cost of monitoring the multitude of small companies was simply too high; government administrators thought that resources should be focused in order to get the largest benefit. The result was that government regulations focused on larger firms and, to a large extent, ignored smaller firms.

THE GROWTH OF TECHNICAL ASSISTANCE PROGRAMS

In the 1980s, however, these assumptions began to change. As larger, regulated firms started to reduce their pollution and better manage their environmental performance, regulators realized that small firms, collectively, could have a significant impact on the environment and could no longer be ignored. Moreover, if small firms were properly educated, they could also adopt pollution prevention practices. This would not only improve their environmental performance, but also help their operational efficiency. The key problem was that small firms simply did not have access to technical information on pollution prevention. As discussed by Rogers (1983), the first stage of any diffusion process is a firm's exposure to the existence of the alternative technology and an understanding of its form and function. Information dissemination, therefore, was at the forefront of many formal technical assistance programs, for both government and

industry. The logic behind these programs dictated that firms with greater access to information on pollution prevention technolog- would be more likely to adopt this technology (US GAO, 2001).

As a result of these changing assumptions about small firms, there was an explosion of experimental technical assistance programs at the national, state and local levels. These programs, developed in the 1990s, were designed to promote pollution prevention and compliance with environmental regulation through a variety of mechanisms including site assessments, workshops, videoconferences, technical literature development and dissemination, and focus groups. Figure 1 outlines some of the programs that were created specifically for printers.



* Known as the Common Sense Initiative from 1990-2000
**Flexographic Printing Project started in 1996

Figure 1. A selection of programs created to assist small printers.

Findings

The extent to which these programs have been able to influence the diffusion of new environmentally superior technologies remains a question. In our survey, respondents were asked to report the degree to which a variety of sources provided useful information on environmentally superior technology. Responses were made on a scale of 1 to 5, with 1 meaning "not useful at all" and 5 meaning "extremely useful." Many printers reported that they do not consider either state or federal government programs to be useful sources of environmental information. As can be seen in Table 1, the most influential sources of environmental information were instead other companies, such as suppliers, competitors, and trade associations, and customers.

Organization	Mean	SD
Equipment Suppliers	3.0	1.27
Ink Suppliers	3.0	1.27
Trade Associations	2.9	1.3
Fountain Solution Suppliers	2.7	1.33
Other Printers	2.4	1.19
Substrate Suppliers	2.2	1.24
Customer	1.9	1.14
State Government	1.6	.98
Federal Government	1.5	.74
POTW	1.3	.67

Table 1. Usefulness of Various Types of Organizations for Providing Information on Environmental Technologies

Additional analysis (T tests comparing firms below and above 100 employees in size) revealed significant differences according to firm size. Larger printers, for example, were more likely to find government sponsored technical assistance programs more useful than smaller firms. Larger firms also reported greater usefulness for all potential information sources and significantly higher usefulness of environmental information from trade associations and suppliers. One explanation for this is that larger firms have greater resources and are more involved with trade associations and other networks, giving them greater access to potential sources of information. The relationship between firm size and membership in trade organizations, while not as strong, still existed for activity in trade associations. This suggests that smaller printers, although they are the most in need of these programs, are also the least likely to find them useful.

Respondents were also asked about specific organizations that provide information about

environmental technologies (see Table 2). The same question was posed: "To what degree have the following sources provided useful information on environmentally superior technology (i.e., information that has led to active exploration of a new technology within your company)?" Because respondents were asked about specific organizations, however, they were given the option to indicate that they were unfamiliar with the program. For all programs other than the Graphic Arts Technical Foundation (GATF), between one third to one half of the respondents reported that they were unfamiliar with the organization in question. This indicates that a significant percentage of the industry has no knowledge of the environmental programs targeted specifically to them. Second, of the firms familiar with the programs, 60 to 84% of the firms indicated they were "not at all useful." Again, GATF is the exception, with only 28% of the respondents indicating that the organization's environmental information is not useful. The GATF was the only organization listed in the survey that is an industry association. It traces its beginnings as far back as 1924 and is a member organization with a mission that is much broader than the others. PNEAC, the Printers' National Environment Assistance Center, which is supported by a partnership between the GATF, the EPA, University-based technical assistance programs, and PIA (Printing Industries of America), had a surprising 45% of firms respond that they were unfamiliar with the organization. The respondents who were familiar with PNEAC, however, reported that it provided the most useful information.

		EPA, DfE (1)	State Technical Assistance Programs	MEP (2)	Local Small Business Assistance Programs	PNEAC (3)	Graphic Arts Technical Foundation
Unfamiliar	0	41%	30%	36%	18%	45%	12%
Familiar	0	59%	70%	64%	82%	55%	88%
Of Firms That Are Familiar	Extremely Useful = 5	2%	30%	36%	18%	45%	12%
	4	5%	70%	64%	82%	55%	88%
	3	8%	3%	3%	2%	0%	11%
	2	10%	4%	0%	4%	2%	22%
	Not Useful At All = 1	75%	13%	3%	8%	9%	23%

1. U.S. Environmental Protection Agency, Design for Environment Program
2. National Institute of Standards and Technology, Manufacturing Extension Program
3. Printers' National Environmental Assistance CenterTable

Table 2. Usefulness of Specific Organizations for Providing Information on Environmental Technologies

Interviews with printers and program managers offered several explanations as to why firms did not view government funded technical assistance programs as useful sources of information. Some printers did not feel that the information provided by these organizations was contextually relevant. As explained by one printer, "Yes, I read all of [the pollution prevention information from the government] – but what I question is how accurate and applicable it is in our specific situation. You know the junk that the government gives out…[we got our information] mostly from our vendors. The regulators just don't know enough about technology." In another study, Bierma and Waterstraat (1995) also found that businesses are more likely to see suppliers, competitors, and accountants as sources of credible information regarding new technologies, rather than government assistance programs.

In addition to credibility and technical accuracy, existing models of technology diffusion are increasingly pointing to the importance of "social capital" in encouraging diffusion of new technology within industries. This research places a greater focus on the importance of personal familiarity, professional networks, and trust in getting to adopt new technologies (Adler 2001; Adler et al., 2001; Adler & Kwon, 2002; Fountain, 1998). Since all innovations carry some uncertainty, the individuals within a firm supporting technology feel a need for social reinforcement of their attitudes toward the idea (Rogers, 1983). Given this need, information from peer groups is simply seen as more reliable than others.

Regulatory sources not only operate with less social capital, but are even seen as a source of danger to some firms. Government is still seen by most firms a hostile, though this view is changing in some circles (Lindsey, 1998). As a result, those firms that need help the most are least likely to go to government sponsored programs. As explained by one person from the EPA, "If you're in decent shape from… a regulatory compliance perspective, then you're more likely to have a technical assistance provider, someone to come in and work with you on pollution prevention. But if you've got problems you don't want anyone in your shop." Another program manager at the state level explained, "Even though we're with… the non-regulatory section [of the government], I think when we come and knock on their door, [printers] automatically think the worst."

REFORMING GOVERNMENT INVOLVEMENT WITH SMALL PRINTERS

As shown in Figure 2, government involvement continues to develop as agencies are beginning to experiment with new approaches to technical assistance. These efforts have been fueled by the growing recognition that the combined environmental impact of small firms can be significant, especially when they are not controlling pollution as well as larger firms. This is particularly true in certain notorious sectors, including dry cleaning, photoprocessing, and printing. These sectors are dominated by small firms that use and emit particularly problematic chemicals such as percholorethylene, silver-bearing chemicals, and high VOC fountain and cleaning solutions.

One of the most common approaches being taken to solve these environmental issues is to foster increased cooperation between industry and government. Regulators realize that they are often not viewed as the most credible sources of information; partnering with more credible sources, such as trade associations, can be one way to increase their credibility. The most prominent example of this is PNEAC, a partnership between the EPA, GATF, and PIA. This partnership has led to the development and dissemination of a wide range of printed and video-based information products, regulatory and pollution prevention oriented list-serves, conferences, and referrals to technical and regulatory experts. As shown earlier, companies reported this program as the most useful in their efforts to adopt new environmentally conscious technologies.

Some programs are also exploring ways to include suppliers in government program partnerships. Given the survey findings, this could be a promising way to encourage the adoption of new environmental technologies.

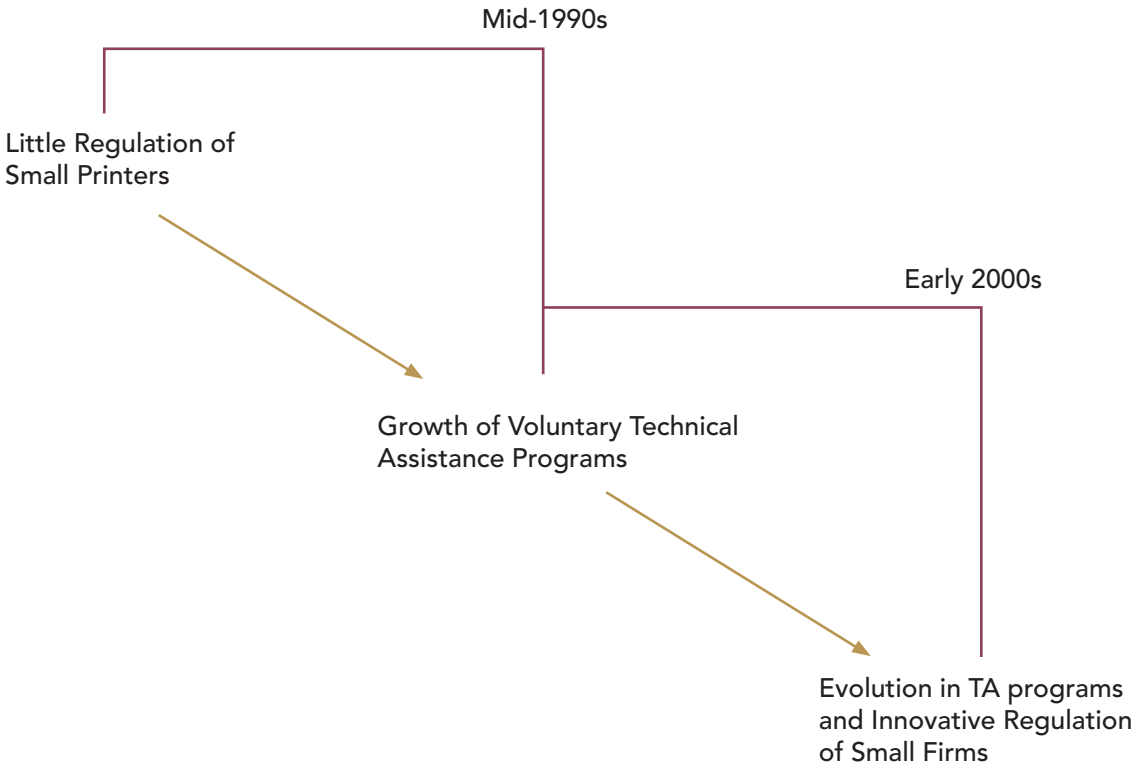


Figure 2. The stages of government intervention with small printers.

The EPA Design for Environment Program, for example, has involved suppliers in a significant way in evaluating and disseminating information on alternative technologies for a variety of industries, including printing. One EPA official noted that suppliers could play an important role in educating their customers about environmental technologies, but they often lack the vocabulary or incentive to do so. This is even the case when suppliers have environmentally superior technologies in their portfolios. Typically, if the sales force raises environmental issues, they are usually limited to regulatory compliance issues and Material Safety Data Sheets. Working with suppliers could increase the sales force's skills in this area, and provide businesses with information that is considered more credible than if coming from a government source.

Another important lesson learned from the survey is that, from a small printer's perspective, the first level of concern is compliance assurance. Until firms feel that they are not in danger of being found in violation of regulations, they will typically be unwilling to work with government partners on proactive pollution prevention. The regulators recognize, however, that if small companies are to be included in the regulatory fold, innovative approaches are needed to ensure that compliance programs are efficient both from the perspective of regulators as well as the printers. State regulators are dealing with lean budgets and know that they cannot afford to regulate and inspect the multitude of small firms. Small businesses are also considered the engine of the economy and it can be politically treacherous to overburden them with regulation. There

are several programs emerging that are experimenting with alternate forms of regulation for small printers.

An important aspect of these new regulatory initiatives is that participating firms can clarify their compliance status and move on to obtaining technical assistance for pollution prevention activities. The Massachusetts Environmental Results Program, for example, is a self-certification program for small business. The program consists of industry specific standards for small business, but no permits. Technical assistance is provided to aid in self-certification and compliance is assured through review of self-certification documents and inspections. By participating in the program, small firms also gain an access route to pollution prevention technology without the threat of traditional regulation. New Hampshire PrintStep is a multimedia, self-certification program aimed at small printers, though already regulated medium and large firms can participate in PrintStep and take advantage of efficiencies of the multimedia permitting aspect. As part of the program launch, small printers were given full amnesty for past behavior, and were assisted with their efforts to reach full compliance. The hope of this program is that these firms will be more likely to seek out technical assistance for future pollution prevention.

Conclusions

Since the mid-1980s, the U.S. Environmental Protection Agency (EPA) and state-level environmental agencies have relied on a variety of voluntary programs emphasizing technical information and direct assistance to encourage the diffusion of pollution prevention technology in small companies. An assumption behind many of these efforts is that diffusion is largely determined by making information more available to the industry. As noted by Geroski (2000, p. 621), "The bottom line seems to be that diffusion is a problem which public policy can ameliorate with a judicious mix of information provision and subsidies."

This study suggests that there are numerous factors that influence this information's ability to facilitate pollution prevention adoption in small companies. Compliance uncertainty, information credibility doubts, lack of trust between industry and government, and lack of resources to access and process this information all have hampered the effectiveness of some of the existing pollution prevention programs. This study points to several ways in which the EPA and others are experimenting with ways to make these programs more effective.

It is important to place a qualifier on these findings. The survey results are limited to the extent that the sample is limited. There was a bias towards relatively large printing firms in the sample (i.e., the population of larger firms was higher in the sample than in the real population), though a large printer by our definition (over 100 employees in this analysis) is still a small firm by most standards. It would be helpful, therefore, to increase the number of small firms in the sample. There may also be some level of self-selection bias in terms of the survey respondents. It is likely that the results may be overly optimistic, as firms with more resources and more interest in attaining external information in exchange for completing the survey are more likely to participate in scouting activity. Finally, this survey did not focus on compliance assistance, even though that is a goal of some of the programs. It is very likely that government programs are more effective at assisting small firms with compliance questions, an area in which credibility is less of an issue (although fear and trust can still be).

It is also important to note that we do not mean to imply that the programs discussed in this paper are not working at all. There are numerous success stories of environmental improvements that have occurred as a result of these programs. In addition, many of these programs were started as experiments, and were meant to be part of a learning process. Assessing their success may only be possible after the learning that evolves from them can be seen.

Additional suggestions for future changes in policy can be made based on this research. Working with suppliers, for example, could be a critical avenue to increase effectiveness of technical assistance programs. Another way that programs can increase the relevance of their information is to couple them with more localized technology demonstrations at peer firms and involve suppliers. For most companies, trying out the new technology or seeing a peer using it is a critical step in forming an adoption decision. Methods to facilitate the trial of innovations will usually speed up the rate of adoption (Rogers, 1983). Alternatively, technology demonstrations at an independent testing facility with the ability to conduct side-by-side comparisons of alternative technology are preferable to testing in a vendor's facility. In a surface cleaning technology demonstration program, researchers found

that firms relished the opportunity to conduct hands-on testing of their own parts in a piece of production-scale process equipment as a means of gathering evidence of the suitability of a new technology to their operation (Becker et al., 2002).

Geroski (2000) offers a model of the diffusion process, in which the primary limitations to diffusions lay within firms. This suggests that the role of government may be even broader than facilitating information flow from suppliers to small- and medium-sized printers. Policies aimed towards building human capital may be just as effective. This assumption also suggests that there are limits to public policy in this area, since there are limitations on the extent to which policy makers (particular environmental policy makers) can actually change the management practices of a firm. It may be up to larger printers, suppliers, and customers to move smaller printers towards more environmentally sensitive technologies. Given the survey results, this may also be the most effective way to facilitate changes.

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