Gaining from Green Management:

Environmental Management Systems Inside and Outside the Factory

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Abstract

Environmental Management Systems (EMS) are a relatively new and rather innovative system of management practices that provide firms with additional sources of information and leverage over their environmental and business processes and performance. They are basically an extension of the total quality approach to the area of environmental management. This article reports the results of a survey of manufacturing plants that examined the reasons why firms adopt environmental management systems (EMS) and their impacts on businesses and communities.

EMS is being adopted by a fairly large group of manufacturing plants. EMS is associated with factories that are larger, more committed to total quality management, and more innovative in general: These enterprises are motivated by the bottom line quest to increase productivity and as well as by government regulation. EMS also appears to be a useful tool for managing community relationships and dealing with key stakeholder groups on potentially controversial environmental issues. EMS factories actively share information with community groups and involve key stakeholders in their environmental activities. Furthermore, EMS plants appear to pose less environmental risk for communities, and report that their adoption and use of EMS is an important factor in achieving this result. In the end, EMS appears to be an effective tool for managing environmental costs and risks inside and outside the factory in ways that adds to – rather than detracts from – the bottom-line.

Introduction

Since the dawn of the industrial age, the goals of economic growth and environmental quality have often been at odds. But, over the course of the past decade, a growing number of companies have pioneered new strategies for integrating the environment into their overall business strategy and for simultaneously improving their environmental and business performance (Porter 1991; Schmidheiny 1992; Smart 1992; Porter and van der Linde 1995a, 1995b; Hart and Ahuja 1994). They are, to turn a phrase, becoming "*leaner and greener*" at the same time (Florida 1995; Florida, Atlas, and Cline 1999). These companies are motivated not just by altruistic concerns, but by a bottom-line quest to increase profits, productivity, and performance by reducing waste and emissions. A new *three zero* manufacturing paradigm is emerging, where companies simultaneously work to achieve zero defects (quality), zero inventory (just-in-time inventory and supplier relations), and zero waste and emissions.

This article examines a new and innovative approach to managing business goals and environmental performance – the rise of **environmental management systems (EMS).** Like other management systems, EMS are a formal system for articulating goals, making choices, gathering information, measuring progress, and improving performance. They are increasingly recognized as the most systematic and comprehensive mechanism for improving environmental and business performance. In many ways, EMS represent an extension of the core principles of total quality programs to managing the environment. Government policy makers are interested in EMS as a possible supplement to or replacement for so-called command-and-control environmental regulation.

While there is a great deal of research on environmental regulation, and a growing body of research on the relationship between environmental regulation and firm innovation and performance, there has been very little, if any, serious empirical research on EMS. This article examines four key aspects of EMS.

- To what extent are enterprises adopting EMS?
- What motivates them to do so?
- Are EMS an effective tool for managing environmental costs and risks inside and outside the factory, particularly for managing key stakeholder groups and community relationships?
- Are EMS an effective tool for sharing information with and interacting with stakeholder groups in the community?

To answer these questions, this article reports the findings of a survey of more than 580 manufacturing plants. (For those who are so inclined, a technical appendix details the survey research methodology).[1]

The remainder of this article is organized as follows. The next section discusses why firms adopt EMS and the key factors that motivate them to do so. It then turns to the effectiveness of EMS as a management tool for dealing with communities and managing stakeholder relationships. The last section outlines the implications of EMS for business strategy and public policy.

[1] Of the 583 plants contacted, 214 responded to the survey. All data identified as "total" is based on this respondent group of 214 plants. Roughly 29 percent (62) of these plants had both an EMS and Pollution Prevention (P2) program in place (high-adopters), while about 46 percent (99) had neither (non-adopters).

Why Do Enterprises Adopt EMS?

Around the country and the world, many companies are moving to adopt advanced environmental practices that bolster both their environmental performance and their competitiveness. But, the evidence to date has been anecdotal and largely based on case studies. We surveyed a reasonably large number of actual manufacturing plants to get a better handle on this issue. We wanted to know how many plants were using EMS and other advanced environmental programs, such as pollution prevention (P2) programs and the reasons why they were adopting them (see Table 1).

First of all, a relatively large number of factories are using EMS. EMS can be described as "the systematic application of business management to environmental issues."[2] More than 40 percent (42.1 percent) of all respondents have an EMS, and a similar number (40.7 percent) have instituted a P2 program (see Table 1). According to the US EPA, "pollution prevention means source reduction – preventing or reducing waste where it originates, at the source – including practices that conserve natural resources by reducing or eliminating pollutants through increased efficiency in the use of raw materials, energy, water, and land."[3] Nearly 30 percent of respondents are classified here as "high-adopters," because they have adopted *both* an EMS and a P2 program. More that 45 percent (46.3 percent) of plants in the entire sample are classified as "non-adopters" – meaning that they had adopted neither an EMS nor a P2 program.[4] It should be pointed out, however, that the results for the overall sample may be biased towards EMS and P2 adopters, due to the fact that the sample of manufacturing plants was

[2] http://www.ems-international.com/what_ems/index.html

[3] http://www.epa.gov/p2/

designed to include plants that showed some level of advanced environmental performance (see Appendix for a discussion of the research design). A more realistic approximation of the actual extent of EMS and P2 adoption man come from our randomly selected sub-sample of plants (N=242), which is based on a cross-section of manufacturers. Roughly a quarter (24 percent) of these respondents have an EMS, and another 28 percent have instituted a P2 program. On top of this, nearly a fifth (18 percent) of this group of plants can be classified as very advanced or "high-adopter" factories – that is, they have adopted *both* an EMS and a P2 program.

Second, these high environmental performance factories differ on crucial dimensions from other factories. For one, they tend to be quite a bit larger, with an average of 250 more employees than other factories in the survey. They also have more people dedicated exclusively to environmental affairs, with more than four times the staff working in environmental, health and safety positions and over three times the dedicated environmental staff. And, they are more likely to be a division or unit of larger companies with more resources to devote to environmental issues.

[4] For purposes of this study, we have focused on three datasets: the total set of all respondents, the set of "high-adopter" respondents, and the set of "non-adopter" respondents.

Table 1: Key Characteristics of Sample Plants

Characteristic	Total (N=214)	High-adopters (N=62)	Non-adopters (N=99)
Environmental Management			
Environmental Management Systems (EMS)	42.1%	-	-
Pollution Prevention (P2)	40.7%	-	-
EMS & P2	29.0%	-	-
Personnel			
Number of Employees	912.4	910.7	677.2
EHS Staff ***	6.0	8.1	2.0
Environmental Staff **	4.2	4.5	1.4
Governance			
Independently Owned ***	43.0%	27.4%	58.6%
Part of Multi-Plant Company ***	47.7%	72.6%	31.3%

Significance:
*** significant at the .01 level
** significant at the .05 level
* significant at the .1 level

Source: Florida, et al., *Community Environmental Impacts Survey* (1999)

Taken together, these findings suggest that factories that adopt EMS and related practices have a greater pool of internal and corporate resources to devote to environmental performance improvement. This is in line with the findings of previous studies that indicate that resources are an important factor in both the adoption advanced environmental management practices (see Florida 1995; Florida, Atlas, and Cline 1999).

The relationship between business performance and environmental improvement has two dimensions (Florida, Atlas, and Cline, 1999). On the one hand, organizations may adopt environmental innovations as a way to reduce costs through improved or more efficient production processes. On the other, environmental improvement may also be a byproduct of changes accomplished to reduce other costs, to improve productivity, and to improve plant performance. A company, for example, may adopt a chemical-free

procedure for paint removal in order to speed up the production process, a decision that also decreases the use of polluting chemicals.

It is even more important to know what motivates companies and factories to adopt EMS and other innovative environmental practices: Are they doing this in response to government regulation, to improve their environmental performance, or to be more efficient and competitive? The data suggests that factories adopt EMS for business benefits as well as for regulatory or environmental reasons. As Table 2 shows, the three top-ranked factors among respondents were business-driven: commitment to environmental improvement (91.9 percent), corporate goals and objectives (88.7 percent), business performance (87.1 percent), followed by community relations (85.5 percent), state regulations (85.5 percent), and federal regulations (83.9 percent). The EMS factories rated corporate goals (2.07) and commitment to environmental improvement (2.54) as the most important factors ahead of state regulatory climate (3.13), business performance (3.46), federal regulatory climate (3.50), and improved community relations (4.38).[5]

[5] Ratings are on a 1-6 scale where 1 is most important and 6 is least important.

Table 2: Factors Motivating EMS and P2 Adoption

Factors	Total (N=214)	High-adopters (N=62)	Non-adopters (N=99)
Commitment to environmental improvement ***	56.1%	91.9%	22.2%
Corporate goals/objectives ***	55.1%	88.7%	20.2%
State regulatory climate ***	54.2%	85.5%	23.2%
Federal regulatory climate ***	53.7%	83.9%	24.2%
Economic benefits/business performance ***	52.3%	87.1%	19.2%
Improved community relations ***	51.9%	85.5%	21.2%
Other	1.9%	3.2%	0.0%

Significance:
*** significant at the .01 level
** significant at the .05 level
* significant at the .1 level

Figures indicate the percent of survey respondents identifying that factor as a motivator in EMS and P2 adoption.

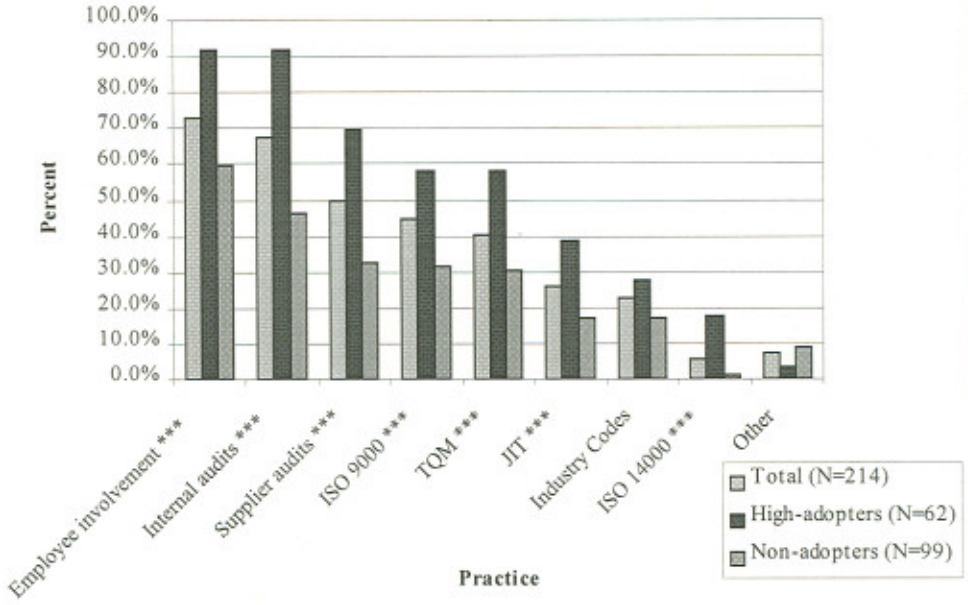
Source: Florida, et al., *Community Environmental Impacts Survey* (1999)

EMS Factories are Innovative Factories

Green companies tend to be more innovative in general and that adoption of advanced environmental practices stems from a deep commitment to finding innovative solutions to reduce waste and improve efficiency (see Florida 1995; Florida, Atlas, Cline 1999). Innovative manufacturing plants also tend to adopt an interrelated bundle of innovative practices such as self-managing work teams, employee input in decision-making, quality management and so on (see Ichinowski, Shaw, and Prennushi 1993, MacDuffie 1994, Jenkins and Florida 1998, Florida and Jenkins 1999). We asked factories about their use of a wide range of innovative management practices from total quality management and self-managing work teams to ISO certification (see Figure 1). EMS factories were significantly more innovative in general. Nearly twice as many EMS plants had total quality management programs and just-in-time systems for inventory control. EMS factories were far more likely to be ISO 14000 certified than other plants.

The use of robust performance measures is a key feature of any effective management system. Environmental performance measures are mechanisms by which companies can jointly improve their environmental and business performance. In fact, a recent study (Florida, Atlas and Cline 1999) found that environmental performance measurement systems were a significant factor in the implementation of environmentally

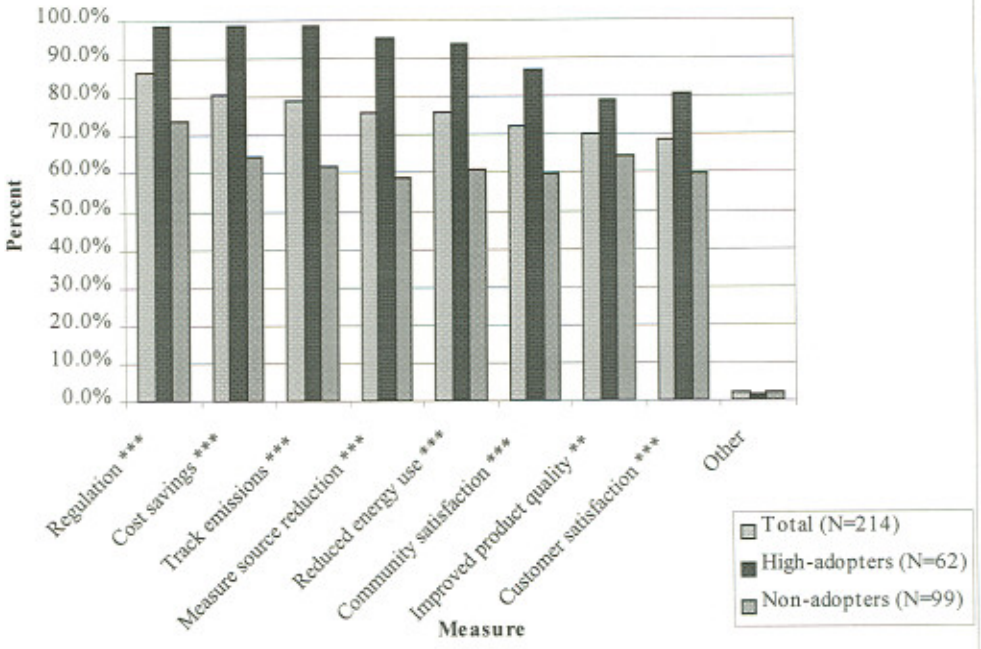
Figure 1: Adoption of Advanced Practices by Sample Plants



Source: Florida, et al, *Community Environmental Benefits Survey*, 1999

conscious manufacturing systems. The survey asked plants about the variety of methods they use to track and measure their environmental performance (see Figure 2). EMS plants were significantly more likely to report using performance measures to track and monitor regulatory compliance, waste and emissions, and customer and community satisfaction. Again, high-adopters were much higher in every category.

Figure 2: Environmental Performance Measures



Source: Florida, et al, *Community Environmental Benefits Survey*, 1999

The summary scores provide a better handle on the adoption of bundles of advanced management practices (see Table 3). EMS factories were much more likely to employ the entire bundle of advanced environmental and management practices, including total quality management, employee involvement, performance measurement systems, and other innovative practices. These plants were nearly twice as likely to use advanced management systems consisting of both advanced innovative management practices and performance measurement systems. Simply put, EMS factories are more innovative factories in general; and, adoption of EMS is associated with plants that are both larger and committed to advanced management systems.

Table 3: Summary Scores for Sample Plants

Advanced Practices	High-adopters (N = 62)	Non-adopters (N = 99)
Assessment ***	70.31	48.17
Management ***	59.38	21.40
Overall ***	64.85	34.78
Community Relations	High-adopters (N = 62)	Non-adopters (N = 99)
Activities ***	23.55	7.27
Involvement ***	16.56	6.77
Information Sharing ***	37.48	18.60
Overall ***	32.65	17.31
Community Environmental Impact	High-adopters (N = 62)	Non-adopters (N = 99)
Direct Impact **	28.19	20.71
Indirect Impact **	32.54	24.04
Overall ***	30.36	22.37

Significance:
*** significant at the .01 level
** significant at the .05 level
* significant at the .1 level

Source: Florida, et al., *Community Environmental Impacts Survey* (1999)

EMS and Environmental Outcomes

In addition to identifying the factors associated with why companies adopt EMS, we examined the impact of EMS on environmental outcomes. We asked plants to identify the ways in which various environmental programs (e.g., EMS, P2, solid waste reduction, recycling, electricity conservation) affect environmental performance. The results are clear: EMS plants were nearly twice as likely to report pollution prevention as a source of plant-level improvement (93.5 versus 69.7 percent); and three times more likely to view EMS as the source of significant in-plant improvement (79 versus 28.3 percent). They were also significantly more likely than other plants to cite the following as sources of plant level environmental performance: recycling (93.5 percent vs. 69.7

percent), air emission reduction (88.7 percent vs. 53.5 percent), solid waste reduction (75.8 percent vs. 54.5 percent), and electricity use (67.7 percent vs. 43.4 percent).[6]

EMS as a Tool for Managing Stakeholder Relationships

A key question is whether EMS is a useful tool for managing stakeholder and community relationships. In other words, does EMS provide managers with an effective mechanism for reducing tensions with government, environmental, and community groups? We were motivated by the simple idea that EMS factories were likely extend the basic principles of quality management outside the factory gates to their dealings with stakeholder and community groups. Indeed, we know from a good deal of research on quality management that these systems foster information sharing, promote team work, and cultivate employee input in decision-making (Shaw, Ichniowski, and Prennushi 1993; Jenkins and Florida 1998). These are all principles that can be extended to dealing with stakeholders and communities. The data certainly suggest a significant correlation between EMS and improved stakeholder relations. Whether there is a causal link between the two or both are products of a well-managed operation is an area for further research.

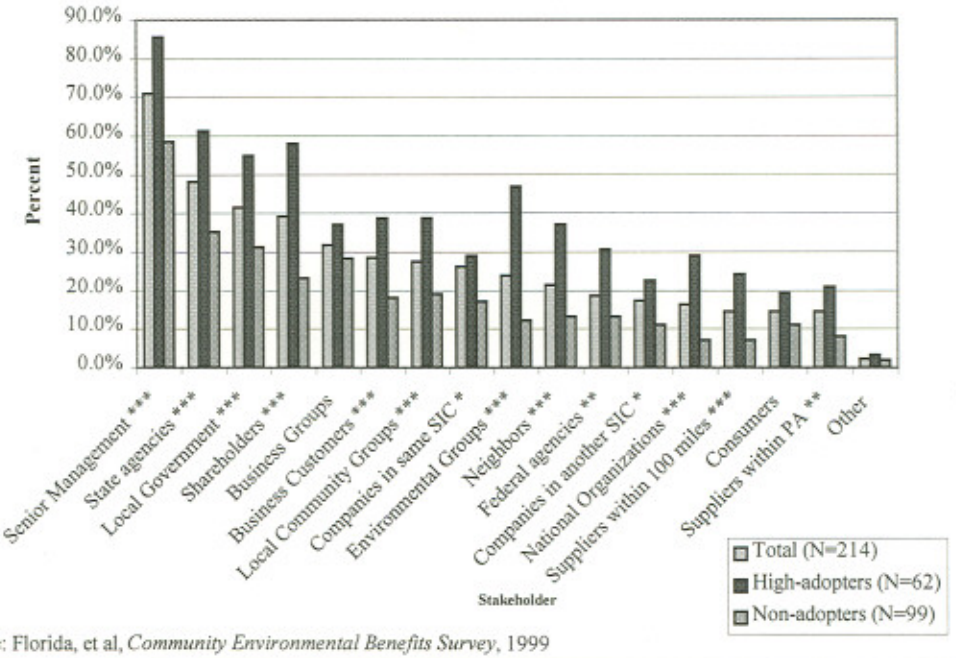
Information Sharing

Information sharing is a key principle of any advanced management system. The survey asked companies about the mechanisms and the frequency with which they share information on their activities with outside groups (see Figure 3). EMS factories were significantly more likely to report sharing information with government agencies,

[6] Overall, EMS plants cited the following programs as major sources of in-plant environmental improvement: pollution prevention (95.2 percent), recycling (93.5 percent), reduction or elimination of air

neighbors, and environmental groups, as well as business customers. They were more than twice as likely to share information with neighbors and four times more likely to share information with environmental groups. Furthermore, EMS plants were four times more likely to engage in private meetings with community leaders and more than six times more likely to engage in broad-based community meetings. They were also much more likely to make use of Citizens' Advisory Councils as mechanisms to share information and gain input.[7]

Figure 3: Environmental Information Sharing



Source: Florida, et al, *Community Environmental Benefits Survey*, 1999

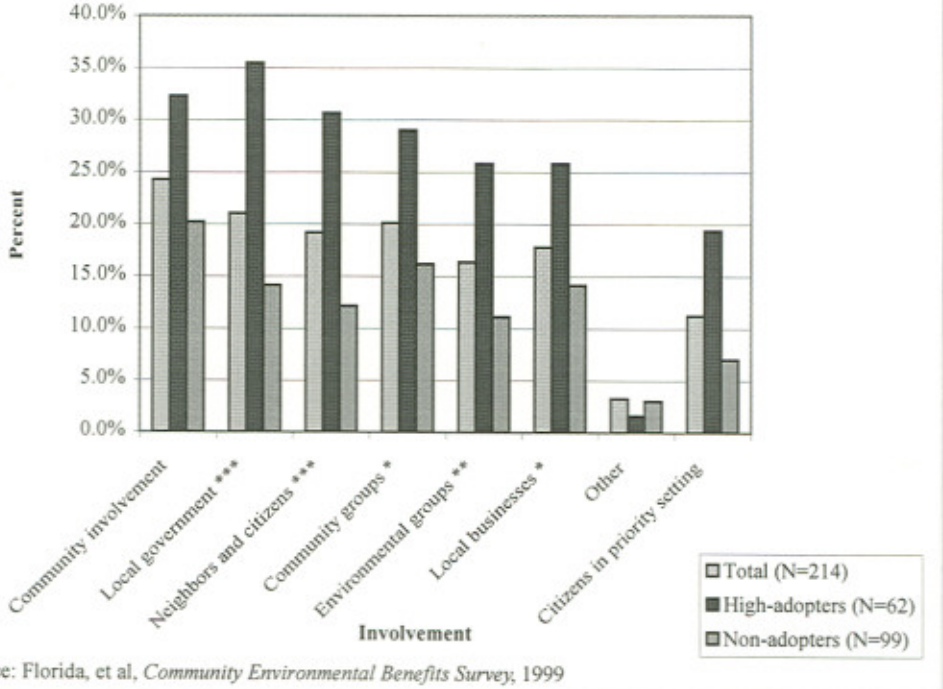
emissions (89.7 percent) worker health and safety (85.5 percent), environmental management systems (79.0 percent) and solid waste reduction and elimination (75.8 percent).

[7] EMS plants were significantly more likely to share information via newsletters (43.5 percent vs. 21.2 percent), local school programs (33.9 percent vs. 12.1 percent), community relations departments (32.3 percent vs. 7.1 percent), private meetings with community leaders (32.3 percent vs. 8.1 percent), community meetings (32.3 percent vs. 5.1 percent), the internet (22.6 percent vs. 5.1 percent), and citizen surveys (16.1 percent vs. 2.0 percent).

Stakeholder Involvement

Another important way that companies can reduce outside tension is by involving key stakeholder groups in environmental activities and initiatives. The survey asked plants about the ways they involve stakeholder groups in their activities (see Figure 4). EMS plants were almost three times as likely to involve neighbors and citizen groups in their environmental initiatives and more than twice as likely to involve local government. EMS plants were also statistically significantly more likely to involve community groups, environmental groups, and local businesses.

Figure 4: Community Involvement in Environmental Program Development



Source: Florida, et al, *Community Environmental Benefits Survey*, 1999

Box 1: "Treating Nature as a Customer"

A large paper products plant in the Midwest has the environmental mission statement "Treating Nature as a Customer." This both reflects and extends the principles that form the foundation of the plant's commitment to best practices in manufacturing management – principles like customer focus, quality, and continuous improvement. The plant has basically extended its commitment to these principles to include the way its deals with community relationships and the environment. "Building community understanding of the positive potential of internally-driven, less command & control approaches to environmental performance is critical to moving forward" in environmental excellence, says the plant's environmental manager.

The plant uses an innovative survey of community residents to identify and prioritize community environmental concerns. The survey enables the plant to anticipate community concerns on issues such as air and water quality and act accordingly. The survey consists of three parts: a questionnaire survey of employees, phone and face-to-face interviews with neighbors, and interviews with local leaders. In effect, the survey is based on the same principles of data collection and analysis that underscores the plant's quality management efforts.

The survey enables the plant to proactively address community environmental concerns. For example, the survey found that citizens were erroneously concerned about possible water pollution from the plant into the nearby river. However, more than 90 percent of the plant's waste is recovered and reused within the facility. So, plant management addressed this issue by increasing its community outreach and education efforts. The survey also found that residents had complaints about odors emanating from the plant. The plant then worked aggressively to improve its odor performance.

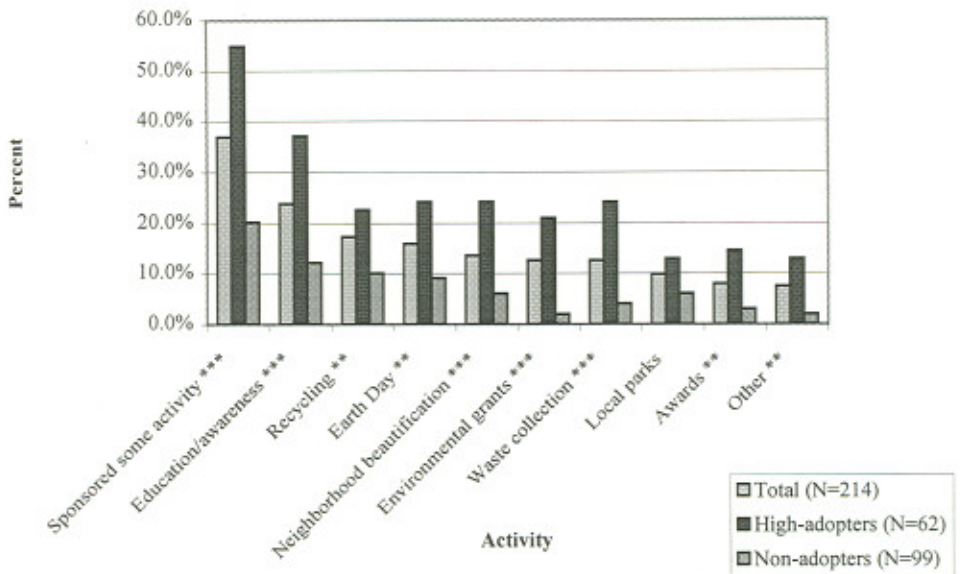
Even more importantly, the survey allowed the plant to realize the role that educated and proactive employees play in community relations. Through this process, the plant came to realize that employees, particularly local residents, could be their best "ambassadors." The plant then took steps to better educate and equip its employees to become more proactive in addressing and improving community relations.

Environmental Activities

EMS factories were also more likely to sponsor community environmental activities (see Figure 5). EMS plants were more than twice as likely to support recycling and earth day events, three times more likely to sponsor environmental awareness programs, and four times more likely to sponsor neighborhood beautification programs.

They were over ten times more likely to provide grants for local environmental projects and activities. Indeed, EMS plants devoted considerably more financial resources to community environmental activities than other factories – an average of $12,750 vs. $5,666 per plant.

Figure 5: Community Environmental Activities



Source: Florida, et al, *Community Environmental Benefits Survey*, 1999

Community Relationships

The survey asked respondents to report on the perceived changes in their relationships with surrounding communities. To get at this issue, the survey asked for respondents' perceptions in the change in their relationship with the surrounding community over the past five years. Respondents were asked if they would classify relations as much improved, improved, unchanged, worse, or much worse. EMS plants were significantly more likely to report that their relationship with the community had improved. Nearly three-quarters of EMS plants (72.4 percent) reported that their

relationship with the surrounding community was either improved or much improved compared to 44.6 percent for other plants.

Perhaps an even better way to gauge the nature of the community relationships is to probe the way that communities react to potentially sensitive proposals from manufacturing plants. The survey asked about community responses to potentially sensitive events, such as permit applications, permit revisions, or plant expansions.[8] EMS plants were much more likely to characterize their relationships with communities as "supportive" across all of these dimensions. Between 80 to almost 90 percent of EMS plants reported that relationships with their communities were supportive across these dimensions compared to between 60 and 66 percent of other plants.

We used "summary scores" to provide an overall picture of EMS as a tool for managing involvement and community relationships (see Table 3 above). EMS factories consistently outperformed other plants across all dimensions. EMS plants scored three times higher than other plants in sponsoring community activities (23.55 compared to 7.27), twice as high on information sharing (37.48 compared to 18.60), and more than twice as high on stakeholder involvement (16.56 compared to 6.77). Overall, EMS plants outscored other plants by a factor greater than two (32.65 to 17.31).

The upshot of this is that EMS plants were considerably more likely to share information with the community and to obtain input from key stakeholder groups in their environmental decision-making and priority setting. As we have seen, one of the study's field research plants went so far as to create and implement an environmental survey of plant employees, community residents, and other stakeholders (see Box 1). Another

[8] We did this in order to identify specific types of plant actions that could provoke a negative community reaction. This allowed respondents to identify recent sources of friction with their communities and served as a check against excessively positive estimates of community relations.

plant we visited, spurred by a number of community complaints about noxious odors, instituted a community information-sharing program as a part of a larger set of plant improvements (including EMS and ISO 9000 certification) (See Box 3). Practices like these reflect the same basic principles of information sharing and employee involvement that underpin innovative management systems. In other words, EMS factories are extending the principles of advanced management practices to their dealings with local communities. EMS is a useful and effective tool for managing stakeholder involvement and community relationships and reducing tensions in this traditionally highly adversarial arena.

Box 2: Being Part of the Community

A large battery making plant goes beyond the norm to forge a positive and enduring relationship with the community. The company has a strong commitment to the environment. The company has had a formal Environmental Management System and pollution prevention program since 1990 and is unique among battery manufacturers for its ability to recycle virtually 100 percent of a lead-acid battery.

The plant has built an on-site water treatment infrastructure that produces highly purified water for use in the manufacturing process. Spent acid is used, instead of water, to dilute highly concentrated incoming acid to use in new batteries. This wastewater reuse program has reduced the need for well water by over 55 million gallons per year while eliminating this amount of effluent being discharged. The plant's production of hazardous sludge needing disposal has decreased from nearly 5000 tons per year in the early 1990s to less than 175 tons in 1997. The acid reclamation initiative has reduced off-site shipments of spent battery acid from 8500 tons in 1990 to less than 300 tons annually from 1995 to 1997. The plant's plastic battery case recovery program has reduced off-site shipments of battery casings from more than 3000 to roughly 400 tons per year. Recovered sulfur dioxide emissions are converted to fertilizer.

The plant has worked hard to maintain close ties to the community, going far beyond what is traditionally done. For example, the company helped finance the community's construction of a public waste treatment facility in 1996. Realizing that its facility would generate roughly 60-70 percent of the treatment plant's load every year, the plant offered to pay its share of the costs in a lump sum so that the community could

avoid borrowing money to meet construction expenses. In addition to providing the money for the plant's construction, the factory continues to offer assistance in the form of lime, equipment, and advice to keep the treatment plant operating smoothly.

When a tornado hit the community, the plant was integrally involved in the cleanup effort, providing equipment and personnel to assist in this effort. The mayor lauds the plant as extremely good and concerned neighbors.

EMS outside the Factory Gates

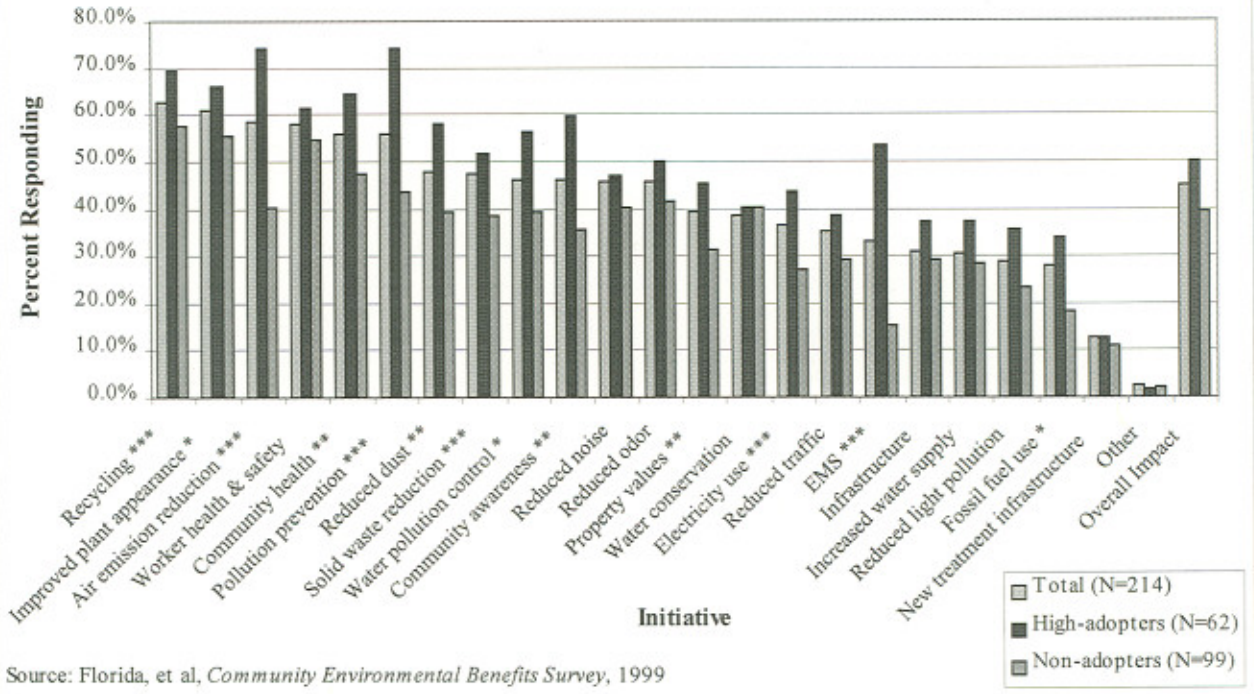
We have looked at the reasons why companies and factories adopt EMS, and the way it affects their relationships with communities and stakeholders, but the question remains. Do environmental management systems enable plants to better manage their emission and waste streams in ways that pose less environmental risk to the communities in which they are located? The analysis focused on two types of environmental risks: the **direct environmental impacts** that stem from waste and emission streams; and the **indirect impacts** that stem from what can termed esthetic or quality-of-life issues such as dust, odor, or the appearance of the factory.

The short answer is that EMS appear to be an effective and useful tool for managing environmental risk outside the plant. The EMS factories in the survey consistently reported posing less environmental risk and conferring more significant benefits than other plants on both dimensions of environmental risk (see Figure 6).

First, EMS plants were more likely to identify direct reductions in community environmental risk through a range of emission reduction and waste elimination strategies particularly: air emission reduction and elimination, solid waste reduction and elimination, energy use, fossil fuels, water pollution control, and recycling. As we have already seen, one field research site was successful in reducing its demand for community

water by over 55 million gallons per year, while also reducing its production of hazardous sludge waste from 4840 tons per year in the early 1990s to only 174 tons per year in 1997.

Figure 6: Community Impact of Environmental Initiatives



Source: Florida, et al, *Community Environmental Benefits Survey*, 1999

Second, EMS factories were much more likely to report making esthetic improvements. The importance of these kinds of improvements should not be minimized: The field research confirmed how important esthetic improvements such as reduced odor and dust or improved plant appearance can be to communities and residents. Nearly 60 percent of EMS plants reported reducing dust compared to 39 percent of other plants in the survey. And, two-thirds of EMS factories reported improving their plant's appearance compared to 55 percent of other plants in the sample. EMS plants were also

more likely to report community benefits through increased local property values, 43.5 percent compared to 31.3 percent for other plants. One of the study's field research plants made a dramatic improvement in community esthetic quality by reducing the emission of odors (See Box 3). They accomplished this turnaround simply by treating community complaints as a tool rather than as a nuisance. By utilizing these complaints as a starting point for internal investigations and improvements, the plant improved community relations while also improving community quality of life.

Box 3: Addressing Community Concerns and Reducing Odor

A chemical plant had a long history of conflict with the surrounding community over plant odor and water pollution. The plant's efforts to reduce its water pollution created a severe community-wide odor problem. During the 1960s, the plant had operated with the prevailing technology of the times, using wet scrubbers to remove pollutants from the air and transfer them to the sewer system. In early 1970, the plant purchased its first thermal oxidizer to burn the vapors from the alkyd resin plant.

During the 1980s the facility added a glycol recovery system. Waste material is distilled to separate liquid that can be reused as a raw material in the plant from vapors that could reliably be eliminated in the thermal oxidizer. This improvement brought the plant into alignment with current pollution prevention programs, emphasizing reuse rather than waste treatment, but it did not address the odor problem.

The plant's commitment to community relations is reflected in its process for handling odor complaints from the public. The plant now openly shares environmental information with local officials and neighbors. The plant encourages residents to call if they detect odors that they believe are coming from the plant. It responds to each odor report with a thorough investigation, a community tour, and follows up visits and phone calls to the initial caller to report their findings.

The plant now registers only about 12 odor complaints per year. In fact, a local air quality inspector reported that he has not been able to find a legitimate odor problem at the plant since the early 1990s.

Third, an obvious way that manufacturing plants impact the surrounding communities is by providing jobs for community residents. The survey asked plants if their EMS had: (1) eliminated jobs, (2) had no employment impact, and (3) retained jobs that otherwise would have been eliminated, or (4) added new jobs. More than half of EMS factories (56.2 percent) reported that they added or retained jobs as a result of major environmental programs and initiatives compared to 26.3 percent of other plants.

Fourth, EMS factories appear to be able to leverage initiatives that have led to environmental performance inside the plant to reduce environmental risks outside the factory gates. Several of the most commonly identified sources of plant environmental impacts were also cited as sources of community environmental benefit, particularly recycling, pollution prevention, air emission reduction, solid waste reduction, electricity use, and EMS.[9]

Fifth, EMS plants were much more likely to view EMS as a key factor in reducing community environmental risk. Three-quarters of these plants cited their pollution prevention efforts as having a significant impact on community environmental quality compared to 43.4 percent of other plants. More than half of EMS plants reported their EMS as having a positive impact on community environmental quality compared to 15 percent of other plants.[10] Nearly 60 percent of EMS factories reported their efforts to increase community awareness of pollution prevention as having a significant positive impact on the environment compared to 35.4 percent of other plants. EMS factories were

[9] As noted earlier, more than three-quarters of EMS plants cited pollution prevention, recycling, air emissions, worker health and safety, environmental management systems, and solid waste reduction and elimination as key sources of environmental improvement inside the plant. EMS plants were nearly twice as likely to report pollution prevention as a source of plant-level improvement, and more than three times more likely to view EMS as the source of significant in-plant improvement.

much more likely to rate their EMS as a source of community environmental improvement (3.43 versus 2.64 percent).[11]

We also asked companies about the factors that have the greatest effect on their ability to reduce outside environmental risks and positively impact community environmental conditions. The survey asked respondents to identify and rate the importance of factors such as: environmental regulation, business leadership, quality of local government, effective partnerships, active citizen involvement, and active environmental groups. More than three quarters of EMS plants rated each of these factors as important compared to half to two-thirds of other plants. EMS plants were much more likely than other plants to identify active citizen involvement and active environmental groups as important.

Summary scores were used to broadly assess the issue of managing environmental risks outside the factory (see Table 3 above). These scores indicate that EMS plants pose considerably less environmental risk and potentially greater environmental benefits. EMS factories outscored other plants in overall community impact (30.36 to 22.37), direct community impacts, e.g. waste and emission reduction (28.19 to 20.71) and indirect impacts, e.g. environmental aesthetics (32.54 to 24.04).[12]

For these reasons, EMS appears to be an effective management tool for reducing environmental risks outside the factory gates. Furthermore, EMS plants seem to be extending the basic lessons and efficiencies generated by practices originally implemented inside the factory to their relationships with and environmental impacts on

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[10] Both of these results are statistically significant at the .01 level.

[11] On a 1-4 scale where 4 is most important and 1 is least important. This was the only response category that was statistically significant at the .01 level.

[12] All of these findings are statistically significant

communities. Indeed, there appears to be some significant overlap in the practices that are the source of both environmental performance improvement inside the plant and of reduced environmental risks to communities.

CONCLUSIONS AND RECOMMENDATIONS

Environmental management systems are a relatively new and rather innovative management practices that provide firms with additional sources of information and leverage over their environmental and business processes and performance. This article has explored why firms adopt them and how effective they are as a management tool for managing environmental risks, stakeholder issues, and community relationships as well as environmental and business performance inside the factory.

As the previous pages have shown, EMS are being adopted by a fairly large group of manufacturing plants. EMS is associated with factories that are larger, more committed to total quality management, and more innovative in general. These enterprises are motivated by the bottom line quest to increase productivity and as well as by government regulation. EMS also appears to be a useful tool for managing community relationships and dealing with key stakeholder groups on potentially controversial environmental issues. EMS factories actively share information with community groups and involve key stakeholders in their environmental activities. Furthermore, EMS plants appear to pose less environmental risk for communities, and report that their adoption and use of EMS is an important factor in achieving this result. In the end, EMS appears to be an effective tool for managing environmental costs and risks inside and outside the factory in ways that adds to – rather than detracts from – the bottom-line.

This poses important implications for business and government policy-makers. To fully capitalize on the potential public and private benefits underlying the shift to EMS in particular and innovative management in general will require more than just change on the part of government regulators. It will require considerable changes in the way that firms manage their environmental and business practices and also in the ways that communities forge partnerships with business. The days when adversarial relations between business, communities, and governments could generate large and significant environmental benefits are long gone. The new era will require mutually beneficial strategies to optimize environmental and economic benefits

The first and in many ways most important recommendation to flow from this analysis is that business has much to gain by adopting EMS. As we have seen, EMS provide real tangible benefits in the form of improved compliance, reduced environmental risks, improved stakeholder management, and better community relations. On top of their utility as a management tool, EMS may be even more important as part of the full package of practices and systems required of an innovative, high-performance business organization. Another way of saying this is that EMS is an indicator of being a highly innovative enterprise. Simply put, innovative plants do it all – that is, they adopt advanced environmental practices as part of an overall strategy of good management.

Business can gain by extending the principles of EMS to their dealings with outside stakeholders and communities. As we have seen, EMS are associated with improved community relations and better relations with key stakeholder group. The most innovative enterprises have learned that they can effectively use the same principles of information sharing and of harnessing the full knowledge input of their employees to help structure their relationships with communities. These companies

readily share information with communities and provide mechanisms to effectively obtain stakeholder input on environmental issues. In this regard, EMS are effective management tools which enable firms to better anticipate and proactively address potential environmental risks, community concerns, or regulatory issues before they become more substantial problems.

Government policy-makers must recognize and act on the potential of EMS and other advanced practices. While regulatory compliance remains an important driver of environmental performance and of the adoption of EMS and other advanced practices, business factors such as cost savings and improved business performance are just as important, if not more so. The existing system of environmental regulations treats firms or plants as homogenous. But, the evidence here suggests that there is considerable heterogeneity among plants. It is clear for example that larger plants with more organizational resources are more likely to adopt advanced environmental practices and pose less environmental risk. Government regulators would be better served by allocating their attention and resources toward firms that do not have such systems in place, particularly small- and medium-size firms that lack the required resources to adopt them. It is in this sense, that EMS or EMS-like practice such as ISO 14000 certification may well be able to serve as a mechanism to direct the allocation of scare regulatory resources and effort.

Government policy should also recognize that environmental violations may frequently be symptoms of deeper deficiencies in manufacturing and management systems. A particularly important implication of this research is that a considerable fraction of environmental violations may reflect a lack of organizational capacity, particularly on the part of small- and medium-size firms – that is, of old technology, out-

of-date manufacturing systems, and a lack of EMS-like practices. Solving environmental problems in these enterprises may require coping with these deeper technological and production deficiencies.

These strategic recommendations are offered as food-for-thought for business and government policy-makers contemplating the new era of business-led environmental management. It takes considerable effort, energy and time to revise systems of regulation and public policy: Such major shifts do not occur overnight. Clearly, government policy will take time to adjust to the needs of new business realties. This nation – along with the rest of the world – is still in the early days of the new system of more flexible regulatory approaches and business-enabled environmental performance. But, it is just as clear that the new era is upon us – there is no turning back. Enabling, encouraging, and navigating this process of change in a way that achieves far-reaching and positive environment results is the task of the next generation of business leaders, corporate environmental strategists, and public policy makers.

APPENDIX: RESEARCH DESIGN

This study is principally based upon a survey of manufacturing establishments. The survey collected information on:

- plant characteristics (e.g. plant size, industry, and employment),
- adoption of advanced environmental and management practices (e.g. environmental management systems, pollution prevention, quality management, ISO 14000, etc.),
- community environmental activities, modes of information sharing, and mechanisms for obtaining community input on environmental priority-setting and information sharing,
- community environmental impacts (e.g. waste and emission streams, noise, odor, and employment).

The survey was administered between September 1998 and February 1999. The survey instrument was pre-tested with a small sample of manufacturing plants. Experts in survey design and community environmental impacts from academia, the consulting community, industry, environmental groups, and government agencies also reviewed the survey instrument.

It is important to keep in mind that the findings mainly reflect the perceptions of manufacturing plants on the nature of their environmental performance. While the field research did include interviews with community representatives, the survey research was based upon the viewpoints of manufacturing plants only. These perceptions may not accurately reflect reality, but should be viewed as a first step toward assessing that reality. The research findings should be interpreted with this caveat in mind.

Survey Sample

The survey was administered to a total of 583 manufacturing plants in the state of Pennsylvania. The sample was designed to compare the environmental performance of advanced environmental plants to that of non-advanced plants. To accomplish this, the overall sample was composed of three sub-samples. The first sub-sample (N=242) was a stratified random sample of all manufacturing plants in Pennsylvania. This group was stratified by industry and size and selected from the *1998 Harris Directory* of manufacturing plants in Pennsylvania. Two additional sub-samples were used to ensure that the sample included a significant number of plants that had adopted advanced environmental practices. A second sub-sample (N=66) was drawn from manufacturing plants that were recipients of the Pennsylvania Governor's Award for Environmental Excellence for the years 1996 and 1997. The third sub-sample (N=275) represents plants that have shown some interest in advanced environmental practices and was drawn from lists of manufacturing firms that participated in regional Pollution Prevention Roundtables.

Survey Administration

The survey was administered by facsimile and included follow up facsimiles and telephone calls to maximize response rate. Approximately two weeks after the initial fax, a second fax was sent to those companies that had not yet responded. After another two to three weeks, follow-up phone calls were made to plants that had not yet responded. At that point, plants were given the option of being removed from the initial survey and being classified as non-respondents.

Of the 583 sample plants, 158 indicated that they were unwilling to participate in the survey. Of the remaining 425 plants, 214 responded to the survey for an adjusted response rate of 50.4 percent. This comprises the total group of respondents ("Total" in the preceding figures and tables). Of those 214 respondents, 62, or 28.97 percent, had adopted both an EMS and a P2 program ("High-adopters" in the preceding figures and tables) and 99, or 46.26 percent, had adopted neither an EMS nor a P2 program ("Non-adopters" in the preceding figures and tables). A wide range of manufacturing industries was represented in the sample. The top three industries represented were chemicals and allied products (12.6 percent), primary metals (10.3 percent), and fabricated metals (10.3 percent). Electrical and electronic machinery (7 percent); rubber and plastic products (7 percent); paper and allied products (6.5 percent); electric, gas, and sanitary services (6.5 percent), and non-electrical machinery (6.1 percent) all comprised more than five percent of the sample. Fourteen industries composed 1 percent or more of survey respondents. It is important to keep in mind that the findings mainly reflect the perceptions of manufacturing plants on the nature of their community environmental performance. While the field research did include interviews with community representatives, the survey research was based upon manufacturing plants only. The research findings should be interpreted with this in mind.

Field Research

Field research was used to supplement and extend the findings of the survey research. Because of limits of time and resources, it was impossible to develop a large number of field research sites across the entire distribution of plants or to utilize control groups or matched pairs of plants. Field research sites were selected from survey

respondents who had adopted advanced environmental practices (e.g. EMS and P2 programs). Sites were also selected to account for different sizes of plants in different types of communities.

Company reports and government documents were reviewed for plant background. Preliminary phone interviews were conducted with plant management and environmental representatives, to obtain information on environmental initiatives and community impacts and to insure that the plants were viable field research candidates. Site visits, including a plant tour, of approximately ½ day were conducted at each facility. A team of two social scientists and an engineer with expertise in plant production and environmental and waste emissions control technologies conducted these site visits. Interview questions were developed for each facility based on a review of reports, documents, and their completed survey form, and covered plant practices, corporate practices, environmental performance, community relations, community impacts, and the factors associated with these initiatives. Interviews were conducted with plant management and environmental staff to obtain information on plant characteristics and environmental performance. Interviews were also conducted with community officials, community residents, government agency personnel, and local government leaders to obtain additional information on the community impacts of plant practices. More than two-dozen interviews were conducted at the five sites.

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