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ORGANIZATIONAL DESIGN AND ENVIRONMENTAL PERFORMANCE: CLUES FROM THE ELECTRONICS INDUSTRY

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A congruence model of organizational design suggests that direct reporting relationships between plant managers and environmental quality managers, monetary incentives for environmental performance, and coordination between environmental quality managers and business strategists reduce plant-level toxic emissions. We tested these relationships in a large sample of U.S. electronics facilities. Only a link between plant manager compensation and environmental performance reduced emissions. Subsequent analyses support a reverse causality, suggesting organizational characteristics *result from* (rather than cause) emissions performance and that firms remain reactive on environmental issues. These findings confront theories of environmental management and congruence with provocative questions, which we discuss in depth.

PEELING THE ONION

In strategic management research, the challenging trade-off between the fine grain of a small sample and the statistical power of a larger one is often decided in favor of the latter. This pattern is mirrored in research that draws on strategic management theories to explain how organizations can reduce their impacts on the natural environment. Thus, in the understandable pursuit of sizeable samples, researchers studying environmental performance commonly factor into their theoretical arguments assumptions about internal variables such as organizational routines (Dowell, Hart, & Yeung, 2000), implementation behavior (King & Lenox, 2000), and use of new technologies (Russo & Fouts, 1997) without measuring them directly.

The tendency of researchers in this field to make such assumptions about the internal nature of organizations is not universal, however. Several studies have surveyed facilities and measured internal variables, such as organizational capabilities (Christmann, 2000; Sharma & Vredenburg, 1998) and investments in environmental technology and management systems (Klassen & Whybark, 1999). In taking this approach, researchers in the field have begun to "peel the onion," removing layers of theoretical and empirical aggregation to measure links in the causal chain connecting organizational variables to environmental outcomes.

We continue this effort, using a congruence model of organizational design (Nadler & Tushman, 1992, 1997) to study how internal processes influence environmental performance. Congruence is "the degree to which the needs, demands, goals, objectives, and/or structures of one component are consistent with those of the other" (Nadler & Tushman, 1997: 34). The greater the congruence, the higher is the performance of an organization. We use congruence theory to study whether or not a fit between environmental management processes and critical organizational dimensions enhances one form of organizational performance, environmental performance.

The Nadler and Tushman (1997) framework moves away from a simple dyadic notion of fit, such as a match between strategy and structure (Chandler, 1962), to advance a richer framework based on four organizational dimensions: work, formal organization, informal organization, and the individual. Here, congruence can take many forms, since there are six possible dyadic fits between the four dimensions. We are interested in connections between work and two types of organization: formal and informal. In our empirical setting, we explored answers to three questions advanced by Nadler and Tushman (1997: 35), all of which spotlight process. Two of these questions concern congruence between work and formal organization, and the third concerns fit between work and informal organization.

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The first question is, Are organizational arrangements adequate to meet the demands of the work? In our context, we considered how the process of environmental management (work) could be improved by use of proper formal reporting relationships (formal organization).

Second, Do organizational arrangements motivate behavior that is consistent with work demands? Here, we considered how the process of environmental management (work) could be improved by the use of an incentive-based formal salary structure (formal organization). Finally, Does the informal organization structure facilitate work performance, and does it meet the demands of the work? To address this question, we explored how the process of environmental management (work) could be improved by cross-functional coordination (informal organization).

By introducing the congruence framework to the study of environmental management processes and outcomes, we hope to at once be able to apply a potentially powerful theory to a new context and to peel away a few more layers of the conceptual onion.

CONGRUENCE AND ENVIRONMENTAL PERFORMANCE

Fit between Work and Formal Organization: Formal Reporting Relationships

Organizational design is central to congruence theory, according to which organizations should seek synchronicity between work and formal structures. The right formal organizational structure can smooth communications, energize high-powered incentives, and balance authority and autonomy. Ultimately, there is no "one best way to organize"—different structures are suitable for the performance of different kinds of activities, depending on operation conditions (Nadler & Tushman, 1997). But a match between an organization's design and its work tasks can boost environmental performance.

Instead of focusing on broad classifications of organizational structures, as studies of fit have often done (Chandler, 1962), in our view it is important to adopt a finer-grained perspective. Blau defined structure as "the distributions, along various lines, of people among social positions that influence the role relations among these people" (1974: 12). Within *any* organizational structure, formal reporting relationships are critical determinants of employee conduct. They determine how and where information flows within an organization and ultimately impact decision making. Reporting relationships that are congruent with environmental management processes can boost environmental performance.

We believe that when a facility's environmental quality manager reports directly to the facility (plant) manager, environmental performance will improve.[1] A direct connection from the environmental quality manager to the plant manager supports cross-functional coordination, giving environmental issues greater weight as the corporate agenda is formed. Greater leveraging of ideas should follow smoother communication. Also, positioning the environmental quality manager close to the plant manager sends a clear signal throughout an organization about the importance of that function to the operation and success of the plant. It may help secure legitimacy from outside parties, an imperative for organizations seeking to be environmentally responsive (Bansal & Roth, 2000). Placing the two managers in close contact may also signal the organization's commitment to creating a context necessary for environmental issue championing behavior among other workers (Andersson & Bateman, 2000).

This discussion leads to the following hypothesis:

Hypothesis 1. A facility in which the environmental quality manager reports directly to the plant manager experiences greater emissions reductions than a facility without such a reporting relationship.

Fit between Work and Formal Organization: Incentive-Based Formal Salary Structures

A venerable adage is "what gets measured gets done." A corollary might well be "what gets rewarded gets done." The common sense of humans responding to incentives is not hard to grasp, and agency theory provides some insight into why the use of well-specified goals would be indispensable to environmental management. Monitoring alone may prevent managers from making decisions that conflict with the goals of their superiors (Tosi, Katz, & Gomez-Mejia, 1997), but the problem is that monitoring a facility's environmental quality manager is a challenge. He or she is typically responsible for a myriad of processes and policies, and on a

[1] We use "environmental quality manager" to represent the senior individual responsible for environmental tasks at a facility. There is no generally accepted job title for this individual, but this term is sufficiently flexible that it creates a shared meaning among practitioners and academics. When we contacted facilities, our use of this term created no confusion.

given day may be engaged in creating or implementing policies, meeting with customers, testing mitigation equipment, or some other activity. Given such a varied agenda, it would be difficult at best for superiors to monitor the individual's performance. Therefore, a compensation plan based on fixed salary will create incongruence between a formal organization and an individual because the incentive system will not necessarily elicit the desired behavior.

For this reason, the use of additional incentive-based compensation is essential. This form of compensation, however, creates a subsidiary problem because it is not clear on what the incentive should be based. In an environmental management setting, a variety of goals could be established, as there are many possible measures of environmental performance (Ilinitch, Soderstrom, & Thomas, 1998; Lober, 1996). For example, milestones such as attaining an environmental certification like ISO 14001 or installing an environmental management system might be used, with compensation tied to meeting those milestones. Although such an approach makes sense, it depends on episodic goals that might not create the type of annual, repeating criteria that can be used to measure improvement over time and to assess progress against other facilities. It is also subject to a lack of specificity that can lead to the "folly of rewarding A while expecting B" (Kerr, 1975). For this reason, maximizing congruence requires the use of environmental criteria that are measurable, available across time, and available for other facilities. Emissions performance offers such a measure.

The logic that applies to environmental quality managers largely applies to plant managers. Lothe, Myrtveit, and Trapani (1999) argued that a compensation system that forces managers to focus on both profit-related and environment-related activities can promote sustainability. Anecdotal evidence that making managers accountable by linking merit systems to clear environmental goals is a "best practice" from an environmental leadership standpoint also exists (Dechant & Altman, 1994).

Ultimately, we believe that when clear environmental criteria are used to adjust the compensation of environmental quality managers and plant managers, one can expect higher levels of congruence between the formal organization and the work performed, greater attention to environmental performance, and hence a cleaner facility. An incentive approach is especially useful with criteria that are relatively easy to monitor, since "agency costs" are lower (Gabel & Sinclair-Desgagné, 1993). Our arguments suggest two hypotheses:

Hypothesis 2a. A facility in which the environmental quality manager's salary is influenced by environmental performance experiences greater emissions reductions than a facility without such a compensation component.

Hypothesis 2b. A facility in which the plant manager's salary is influenced by environmental performance experiences greater emissions reductions than a facility without such a compensation component.

Fit between Work and Informal Organization: Cross-Functional Coordination

The frequently overlooked source of congruence between work and informal organization is particularly important in the context of environmental management. This can be accentuated in R&D-intensive contexts, where a degree of structural differentiation makes coordination difficult (Donaldson, 1996: 60). The process of environmental management can isolate environmental quality managers and other professionals. Conflict can emerge when inadequate cross-functional communication reduces the effectiveness of pollution prevention initiatives, which often require cooperation among environmental quality managers, engineers, and production personnel (Cordano & Frieze, 2000). Problems may also result when environmental quality managers fail to properly translate their agendas for business strategists. In both cases, the issues can be traced to a lack of congruence between the work of environmental management and the informal structure of an organization.

One way to remedy this incongruence is to use a cross-functional approach in strategic processes that have environmental ramifications (Maxwell, Rothenberg, Briscoe, & Marcus, 1997). To the extent that individuals from each subunit provide important information, a decision process can be improved. King (1999) found that increased communication between production engineers and pollution control workers created an iterative problem-solving system. Sharma, Pablo, and Vredenburg (1999) proposed that lateral and upward information flows allowed managers to make informed decisions with respect to environmental issues. This dynamic has been documented at HADCO, a printed circuit board manufacturer that owns a facility in our sample, where such communication flows are encouraged (Ochsner, 2000).

Judge and Douglas (1998) showed that coordination of strategy across relevant organizational functions, matched with the provision of sufficient resources, leads to the successful integration of environmental issues into strategic planning *and* advances financial and environmental performance. This finding echoes the sentiment that environmental issues are multifaceted in their own right and consistently require cross-functional coordination (Westley & Vredenburg, 1996). Another benefit of involving environmental quality managers is symbolic—it can signal the importance of environmental issues to a plant or a firm as a whole.

In the setting considered here, we wanted to ascertain whether or not the inclusion of environmental quality managers within discussions of important investment decisions led to improvements in environmental performance. A story relayed to us by an environmental professional provides a glimpse into the importance of such inclusion: Environmental quality personnel from a major semiconductor manufacturer were brought into discussions of a proposed plant addition. They pointed out early in the process that the favored design at that time would not only increase emissions, but push the plant across an important EPA (Environmental Protection Agency) threshold—making it a "major source" of pollution under that agency's statutes. The upshot would be that even minor changes subsequently made to the plant would need EPA approval, a potentially troublesome contingency. In the end, the plant addition was redesigned to keep the facility a "minor source" of pollution. Thus, cross-functional coordination provided an early warning system, saving money, reducing risks, and enhancing flexibility.

We believe that cross-functional coordination gives environmental quality managers a voice in major strategic processes, with salutary effects. We therefore advance this hypothesis:

Hypothesis 3. The greater the degree of inclusion of environmental quality managers in discussions concerning key strategic processes, the greater the emissions reductions at a facility.

ANALYSIS

Sample

To test these hypotheses, we used a sample of electronics plants, broadly defined. Plants, or facilities, were appropriate to analyze because (1) they are important operating units of companies and (2) the Toxics Release Inventory[2] is organized at this level. We collected data for facilities in six industry environments: SIC 3571 (electronic computers), SIC 3651 (household audio and video equipment), SIC 3661 (telephone and telegraph equipment), SIC 3671 (electronic tubes), SIC 3672 (printed circuit boards), and SIC 3674 (semiconductors and related devices). Data furnished by Dun and Bradstreet listed 1,104 such establishments in the United States, of which 95 were dropped because they were in different lines of business or were not manufacturing sites.

A university survey research center randomly selected facilities from the remaining 1,009 facilities and secured cooperation from 316 of the 364 that it was able to contact. In each case, the surveyor asked to be connected to the environment quality manager. Since the survey was conducted in February and March of 2000, we treat survey data as placed at year-end 1999. Of the 316 facilities that were contacted, 147 were dropped from the analyses because the interviewee did not provide information on all variables.

Variables

Dependent variable. Our dependent variable was constructed using data from the the Toxics Release Inventory (TRI). Because the TRI provides information on substances that vary greatly in toxicity, we used a method originated by King and Lenox (2000) to adjust it. Under this approach, we divided emissions of each chemical by a quantity used by the EPA to set an upper limit on what a plant may discharge without having to report a spill to the EPA. These "reportable quantities" vary with toxicity; the more toxic the substance, the lower the reportable quantity. We then aggregated emissions across the chemicals released at a facility to produce what we termed a "toxics release index." Because these data were skewed, we then performed a logarithmic transformation (after adding 1). Formally, the toxics release index can be expressed in this way:

$$\textit{Toxics release index} = \ln[1 + \sum_i (E_i/RQ_i)],$$

where E_i is emissions of chemical i to air, land, and water, if emissions are above the reporting threshold, and 0 otherwise; RQ_i is the EPA reportable quantity for chemical i; and i is an index denoting each of the 529 chemicals that are tracked by the TRI.

Where releases of none of the 529 chemicals exceed threshold levels, this index results in a missing value, because no report to the TRI is necessary. On the other hand, if emissions of at least one

[2] The Toxics Release Inventory is an EPA database containing facility-level information on the release of 579 chemicals and 28 chemical categories.

chemical exceed the threshold, the toxics release index has a value.

Use of the Toxics Release Inventory is now well established in research on environmental impacts of corporations (e.g., King & Lenox, 2000; Klassen & Whybark, 1999). Nonetheless, it has a number of limitations. The first is that the system relies on self-reports of emissions, often using estimates of releases rather than exact measurements. This approach can introduce errors into the system. Second, the reporting procedures may have elicited malfeasance on occasion, manifested in willful underreporting of emissions. In response, the EPA has used a system of fines and other enforcement actions to police the reporting function. A third limitation—more a function of the substances covered in TRI than of the inventory itself—is the differing impacts on the ecosystem of the various toxic substances it includes. We tried to address these differences in our operationalization of the toxics release index in our analyses. A final issue is that the TRI data reflect releases of chemicals but not the level of exposure the public or the ecosystem sustains (EPA Office of Environmental Information, 2002). Thus, the ultimate impacts of releases are not tracked, only the releases themselves. Despite these drawbacks, the TRI does provide a set of values that are consistently reported over time for facilities, the only such source of data for emissions.[3]

Independent variables. To test Hypothesis 1, we derived a variable from survey data that was coded 1 if the environmental quality manager reported directly to the plant manager and 0 otherwise. Testing of Hypotheses 2a and 2b used the survey data analogously, creating variables that were coded 1 if the environmental quality manager or the plant manager, respectively, had a portion of salary tied to environmental performance, and 0 otherwise.

To test Hypothesis 3, we created a composite variable by adding responses from three survey questions, on which interviewees were asked the extent of their agreement (1 indicating strong disagreement, 5 indicating strong agreement) with these statements concerning the inclusiveness of strategic processes (α =.88): "Environmental quality managers are included in discussions about the choices of equipment to be installed at the facility," "Environmental quality managers are included in discussions about fundamental design issues impacting the facility," and "Environmental quality managers are included in discussions about potential process modifications."

Control variables. We included other variables to control for important influences on facility emissions. The most critical of these was size, which we controlled by including the number of employees at each facility, using information taken from interviewees. Since younger plants might be designed more efficiently and cleanly, we included the age of the plant, to try to pick up any influence of its vintage. We used a logarithmic transformation of age in our regressions. To try to control for variation in states' environmental regulations, we used a measure of total toxic releases per dollar of a state's gross domestic product (Meyer, 1995). We used a dichotomous variable coded 1 if a facility had an environmental management system (EMS) in place, and 0 otherwise, and another with analogous coding for ISO 14001 certification. A facility needed to have had an EMS or ISO certification for more than half of the year for that variable to be coded 1. ISO certification requires an EMS, but the reverse is not true. Because many of the facilities in our sample had environmental management systems but not ISO 14001 certification, the correlation between those two variables was relatively low. We expected either system to lead to reduced emissions.

Finally, to pick up the manufacturing strategies of the facilities, we added two variables: product innovation and process innovation. Product innovation was measured by responses (five-point scale on which 1 indicated strong disagreement and 5 indicated strong agreement) to a question first posed by Christmann (2000): "Relative to our major competitors that manufacture in the U.S., we have been a leader in the introduction of product innovations over the last three years." Process innovation was measured in an analogous way.

Statistical Methods

Our goal was to estimate the toxics release index for the year 2000. Using simple linear regression would not have been appropriate owing to the lack of emissions data for numerous facilities. These omissions were not random occurrences—facilities that manufacture or process less than 25,000 pounds and do not use at least 10,000 pounds of any of the EPA's listed chemicals are not required to report to the TRI (EPA Office of Environmental Information, 2002). Our database contained 113

[3]Nonetheless, absent real-time monitoring of actual releases, researchers should continue to exercise some degree of caution when using and interpreting TRI data. A reviewer pointed out that it is possible that it is possible that facilities that perform relatively poorly with respect to emissions might be devoting their energies to changing their business models more fundamentally, so as to leapfrog to more sustainable operations.

such observations, so our estimation procedure needed to account for them.

One approach would have been to use a sample selection bias model (Heckman, 1979). This approach has the disadvantage of reducing sample size, and thus restricting statistical power. Therefore, we used Tobit analysis, a maximum likelihood technique that accommodates "censored" data (Johnson & DiNardo, 1997). The general Tobit model applies when a dependent variable is continuous but bounded; the censored Tobit applies when the dependent variable is only reported above or below some level. This model had the advantage of utilizing data from the nonreporting facilities. To conduct this analysis, however, we had to account for the fact that in many cases, an independent variable was missing—the lagged dependent variable. We modeled lagged effects in the following way: First, we included a dummy variable coded 1 if a facility reported data in the last reporting period, and 0 otherwise. In theory, the coefficient on this variable should model the TRI reporting threshold. A second variable tracked reported emissions; it was set equal to those lagged emissions if reported, and 0 otherwise. Together, these variables model a process in which reported emissions are 0 below a threshold level and then increase with the level of actual lagged emissions.

Our analyses are cross-sectional, but with lagged dependent variables. As noted above, data for key independent variables (e.g., inclusiveness of strategic processes) were placed at year-end 1999. For control variables (e.g., employees and plant age), we had information for a number of years, so we used 1999 data also. For the dependent variable, toxic releases, we also had data for several years but used 2000 emissions to account for prior causality.

Initial Results

Table 1 shows descriptive statistics and correlations for the variables.

Table 2 provides the results of our regression analyses. The strong impacts of the lagged dependent variable and filing status variable indicate the propriety of the modeling approach. Model A contains the control variables, and model B adds independent variables to the equation. Viewing the models together, we see that the addition of these four variables does not significantly improve model fit. Of our independent variables, only the coefficient associated with whether or not a plant manager's compensation is tied to environmental performance achieves a marginal level of significance. None of the variables tracking inclusiveness, reporting relations, or a tie between environmental quality manager's pay and environmental performance are associated with emissions performance.

Turning to the control variables, as one might expect, the presence of an environmental management system is associated with lower emissions. Surprisingly, however, ISO 14001 certification is associated with greater emissions. This might be because a large number of facilities certified just prior to 2000, and they might not have had the chance to fully implement the ISO system. It might

TABLE 1
Descriptive Statistics and Correlations[a]

Variables	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11
1. Toxic emissions index[b]	4.46	3.46											
2. Number of employees	0.54	1.00	.33										
3. Facility age[b]	2.80	0.75	−.12	.04									
4. Statewide emissions per dollar of state GDP	218.84	221.58	.14	.15	.05								
5. Environmental management system in place	0.47	0.50	.02	.20	−.04	.01							
6. ISO 14001 certified facility	0.18	0.38	−.08	.26	.03	.04	.28						
7. Product innovation	3.77	1.22	.25	.16	−.04	−.03	.17	.10					
8. Process innovation	3.50	1.05	.35	.17	−.07	−.07	.05	.05	.44				
9. Direct reporting relationship	0.46	0.50	.17	.05	.01	−.12	.01	−.09	−.02	−.03			
10. Plant manager compensation tied to environmental performance	0.31	0.46	.10	.20	.25	.09	.15	.23	.04	.09	.15		
11. Environmental manager compensation tied to environmental performance	0.31	0.46	.09	.17	.02	−.06	.25	.09	.11	.14	.15	.47	
12. Inclusiveness of strategic processes	11.71	3.11	.22	.10	.14	−.03	.26	.09	.17	.20	.15	.21	.24

[a] $n = 63$ for toxic emissions index variable; $n = 169$ for all other variables. Correlations above 15 or below −15 are significant at the 5% level (one-tailed test).

[b] Natural logarithmic transformation used to correct for adverse skew and kurtosis.

TABLE 2
Results of Initial Regression Analyses for Toxic Emissions Index in 2000[a]

Variable	Model A	Model B
Intercept	−4.96** (1.72)	−5.83** (2.03)
Lagged toxic emissions index	0.91** (0.09)	0.93** (0.10)
Firm filed TRI report	4.26** (0.83)	4.45** (0.85)
Number of employees	0.03 (0.35)	−0.02 (0.39)
Facility age	0.05 (0.40)	0.28 (0.43)
Statewide emissions per dollar of state GDP	0.001 (0.001)	0.001 (0.001)
Environmental management system in place	−0.98* (0.57)	−0.98* (0.56)
ISO 14001 certified facility	1.04* (0.66)	1.34* (0.70)
Product innovation	0.02 (0.23)	0.03 (0.23)
Process innovation	0.26 (0.29)	0.34 (0.29)
Direct reporting relationship between plant and environmental managers		−0.08 (0.53)
Plant manager compensation tied to environmental performance		−1.03† (0.61)
Environmental manager compensation tied to environmental performance		0.27 (0.59)
Inclusiveness of strategic processes		−0.004 (0.09)
n	169	169
Log-likelihood	−150.16	−148.79
$\Delta\chi^2$ for model A vs. B		2.74

[a] Standard errors are in parentheses.
† $p < .10$
* $p < .05$
** $p < .01$
One-tailed tests.

also be the case that ISO 14001 certification, which does not mandate emissions reductions, was seen as a way to "provide cover" for poor emissions performance by appearing to take steps in the right direction. Finally, neither product nor process innovation leaders appear to be leaders in emissions reductions. This finding is somewhat surprising in the case of process leaders, since waste reduction is generally seen as a process imperative (Florida, 1996).

An Extension

Why would several seemingly straightforward relationships not hold in our data? This result was not due to the specification of the dependent variable, because using an alternative measure, emissions divided by plant size, returned similar results. The first reason for this lack of significance might be that in the eyes of facility managers, environmental performance is measured not by TRI emissions, but by some other means. Despite the problems stemming from a lack of clear measurement and comparability to other plants, it may be that the avoidance of spills and other high-profile events is a better outcome than steadily lowering emissions. A second possibility is that data for the year 2000, used for our dependent variable, might have been skewed by the onset of a serious recession in this industry. It is possible that environmental performance was subordinated when market disruptions struck the firms studied here in mid to late 2000.

The third possibility, which we could directly test, was that our independent variables were actually the result of variables in our model, not their cause. Put a different way, is internal change the result of past emissions performance? This might be the case if, for example, establishing a more direct reporting relationship was a reaction to consistently high emissions. Having a plant's environmental quality manager report directly to the facility manager might be seen as a way to address incongruence by tightening up communication and signifying a greater commitment to the environment in the future.

Because we had data on a number of critical variables across time, we attempted to explore this last issue with additional cross-sectional analyses. To do so, we had to address several statistical issues. First, because the dependent variable was dichotomous in several cases, we used logistic regression analysis (like Tobit, a maximum likelihood approach) to estimate whether reporting relationships and pay were tied to environmental performance. We used ordinary linear regression to estimate our inclusiveness variable, which ran from 3 to 15.[4] We included toxic releases as an independent variable, and the same control variables as in our previous analyses. To conduct these regressions, we had to revisit the fact that we had no emissions data for many facilities. Because this variable was now an independent variable, we decided to use the lowest reported emission level for nonreporting facilities, following Klassen and Whybark (1999). Some confidence in this approach emerged from regressions in which only data for facilities with toxic release data were available. Patterns of coefficients were similar to what we found previously, although in several cases significance suffered. We decided to use independent variables (that is, controls plus toxics release data) from the year 1998, to allow them to precede survey data that we placed at year-end 1999 that now was used for the dependent variables. Using 1998 rather than 1999 data for several variables reduced our number of observations because there were eight more instances of missing data for control variables in 1998 than in 1999. Analyses using 1997 or 1999 data for independent variables and controls were very similar.

A separate issue arises from our data. When using our internal variables as dependent variables, we had to note that we only had information on these variables at the beginning of 2000. We did not know their status for any earlier years and so lacked information that could have helped us assess causality by capturing *changes* in policy at a given facility. In that way, we could have tied a change (for example, a determination to begin tying managerial salary to environmental performance) to prior environmental performance. Readers should take this lack into account when reviewing our results. Table 3 shows the results of our additional analyses.

In all four cases, the coefficient on the internal variables is statistically significant, but since model C's overall fit is not significant, that result cannot be considered meaningful. So, in three of four cases, the analyses indicate reverse causality. Several other relationships are worth noting. The older the facility, the more likely managerial pay is to be tied to environmental performance. This relationship might reflect the higher risks of older technology, and a greater imperative to avoid spills. Also, the older the facility, the greater the inclusiveness of strategic processes, perhaps indicating that these organizations had developed cross-functional coor-

[4]Although model fit was modest, no predicted values were outside of this range, indicating that linear regression performed adequately.

TABLE 3
Results of Reverse Causality Regression Analysis Models[a]

Variable	Model C: Direct Reporting Relationship		Model D: Plant Manager Compensation		Model E: Environmental Manager Compensation		Model F: Inclusiveness of Strategic Processes	
Intercept	−0.16	(0.89)	−5.26***	(1.26)	−2.53**	(1.05)	6.92***	(1.33)
Toxic emissions index	0.09†	(0.06)	0.15**	(0.06)	0.15**	(0.06)	0.17*	(0.09)
Number of employees	0.07	(0.17)	0.13	(0.18)	0.25	(0.21)	0.07	(0.26)
Facility age	0.01	(0.19)	0.98***	(0.29)	0.25	(0.22)	0.65*	(0.28)
Statewide emissions per dollar of state GDP	−0.001†	(0.001)	0.001	(0.001)	−0.001†	(0.001)	−0.001	(0.001)
Environmental management system in place	0.23	(0.37)	0.34	(0.42)	0.15	(0.41)	1.00*	(0.55)
ISO 14001 certified facility	−0.36	(0.68)	0.58	(0.73)	−1.52*	(0.89)	−1.44*	(1.01)
Product innovation	−0.01	(0.15)	0.03	(0.18)	0.16	(0.18)	0.33*	(0.23)
Process innovation	−0.01	(0.17)	0.29†	(0.20)	0.10	(0.19)	0.45	(0.25)
n	161		161		161		161	
Log-likelihood	−108.97		−86.00		−92.74			
χ^2 for overall model fit	4.21		27.49***		14.01†			
Adjusted R^2							.08	
F for overall model fit							2.66**	

[a] Standard errors are in parentheses.
† $p < .10$
* $p < .05$
** $p < .01$
*** $p < .001$
One-tailed tests.

dination as their facilities matured. ISO 14001 certification was negatively related to a tie between the environmental manager's pay and environmental performance. One speculative interpretation for this puzzling result is that such certification may lead to compensation being tied to ISO 14001 systems working well, rather than emissions-based environmental performance. Finally, facilities with environmental management systems were associated with greater levels of inclusiveness. Implementation of most systems demands such holistic planning and execution, so this relationship could be expected.

DISCUSSION

Starting at the Top

Our results provide weak support for the idea that incentive systems can elicit desired environmental outcomes. The effect is not uniform, however: environmental performance is enhanced when there is a tie between environmental performance and pay—but only for facility managers, *not* for environmental quality managers. It is possible that environmental quality managers see such a tie as being redundant, especially if they feel that they are doing all in their power to minimize emissions already. For plant managers, however, such a tie could represent a new "carrot" and shift some managerial attention to environmental issues. It may also be the case that the agency problem is more substantial for environmental quality than for other facility performance measures. For example, it may be relatively straightforward to assess a manager's performance with respect to output figures, defect rates, and other production measures. But incentives could be a valuable tool for improving environmental performance, which is more difficult to observe and judge. Here, their effect could be powerful.

Interpreting Reverse Causality

One overarching conclusion that might be drawn from our analysis is that facilities in our sample continue to behave reactively. If in fact policies follow from emissions and not the other way around, exhortations to "prevent pollution in the first place" (Cairncross, 1991), "stay ahead of regulations" (Dechant & Altman, 1994), and otherwise be more proactive have yet to hit home.

Does it matter if appropriate policies are instituted only after a facility recognizes its environmental failings? It might. To appreciate this factor, consider two facilities, one in which the environmental quality manager's pay has always been tied to environmental performance and another in which this link is the result of poor prior environmental performance. If more focused incentives are put in place after relatively poor performance has occurred, the organizational antecedents to improved performance, like employee buy-in, might not exist. A shift in the pay scale might provoke jealousy if it is seen as "rewarding failure." If instead the prior situation were deemed the responsibility of the environmental quality manager, who were then replaced, the new individual would face sizeable start-up costs as he or she tried to institute change.

Takeaways for Congruence Theory

How can we evaluate congruence theory in view of these results? A number of ideas emerge. First, design can be the result of performance, not the other way around. Several writers have used congruence models to assert that there is a progression of fit for any organization as it grows across time. For example, Milliman, Von Glinow, and Nathan (1991) argued that the type of fit changes over the organizational life cycle as a firm expands internationally. In their model, however, changes in human resources policy reflect the organizational life cycle, not necessarily any performance indicators. Our results suggest that performance gaps may play a more central role in triggering redesign.

Thinking along related lines, we suggest that the conditions under which change takes place may also have an impact on process. In our case, poorer environmental performance might be viewed in differing ways by organizations. Perhaps urgency for change was seen in some, while in others financial considerations dominated. Another idea comes from Siggelkow (2001), who argued for a distinction between fit-conserving and fit-destroying changes. His idea was that fit-destroying changes are actually easier to deal with because they strike at the root of current organizational design flaws. In contrast, fit-conserving changes do not elicit an urgency to act, and they may lead to congruence being a "managerial trap" (Tushman & O'Reilly, 1996). If crisis leads to fit-destroying change that loosens organizational rigidities, it would be very valuable to follow our sampled organizations for a longer period of time to see how they responded to the severe economic disruptions of the recent technology slump. If this experience forces managers to instigate fit-destroying change, it could be an opportunity for environmental quality managers to shape an organization's redesign to promote the integration of environmental stewardship and production activities.

Several ideas for further research on congruence emerge from this work. One idea follows from the last point and begins in viewing organizational performance as a multidimensional construct. While financial performance is generally recognized as the critical indicator for organizations, it depends on performance in subordinate, contributing areas like manufacturing efficiency, process innovation, and environmental management. Although several authors have established a link between environmental performance and firmwide performance (Dowell et al., 2000; Klassen & McLaughlin, 1996; Russo & Fouts, 1997), perhaps the organizational designs that drive the two types of performance are not exactly the same. For example, it may be that a tight, functional structure produces low-cost, reliable electronics parts, but a matrix element for the environmental function, which can create inclusion and awareness of this imperative across an organization, might best lead to environmental improvement. How should these seemingly conflicting design elements be resolved?

One possible clue comes from research on the ambidextrous organization (Bradach, 1997; Tushman & O'Reilly, 1996) that builds in tight and loose coupling simultaneously. Although the focus in this research has been subunits, it does provide a platform for beginning to understand how seeming inconsistencies can coexist in organizations and actually promote success. It may be that one key to successful environmental management involves a congruence that we did not explore in this paper—fit between informal organization and the individual. Perhaps a culture with tight-loose elements necessitates recruiting individuals that can deal with its ambidexterity. It may also be true that exploring incentive systems on a deeper level than available data permitted here could reveal new subtleties. Determining how a range of environmental performance indicators impacted behavior would be valuable, but the form of the compensation increment could be important also. Gainsharing, bonuses, and other performance-based compensation plans might have differing congruence properties.[5]

We have shown that congruence theory has much to offer to the study of environmental management. But we looked at only a small part of the model, connections between work and formal and informal organization. Surely there is a rich set of variables at the individual level that could be used to explore fit between individuals and other variables in the congruence model. Consider the individual-organization fit illustrated by the "convergence of individual and organizational goals" (Nadler & Tushman, 1997: 35). Prospective employees judged firms that performed better on social criteria as more attractive (Turban & Greening, 1997). If the same were true of environmental criteria, it would show a tangible benefit of congruence—and broaden the applicability of congruence theory to environmental performance.

[5]We thank an anonymous reviewer for making this point.

A Concluding Thought

Trying to specify the causal system at work in a single large organization is a tall order. To then attempt to find common patterns of causality in a population of like organizations—some more similar than others—can frustrate any scholar. Rather than search for some explanatory "Holy Grail," researchers might best view every analysis as a puzzle piece. Each has limited value on its own but becomes increasingly helpful as additional puzzle pieces are put in place. Our goal in this exploratory study was to provide another piece of a jigsaw puzzle that will tantalize, surprise, and, we hope, inspire scholars as the complete picture comes into view.

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