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Executive Perceptions of Governance and Organizational Influences on Environmental Disclosure: A MICMAC Analysis of Saudi Listed Cement Companies

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ABSTRACT

Environmental disclosure requires coordination between governance oversight, reporting capacity and institutional expectations. This study examines how senior executives perceive those relationships in Saudi listed cement companies. In September 2026, 13 of the 14 companies targeted in an attempted census supplied complete influence matrices through nine chief financial officers and four chief executive officers. Direct and indirect MICMAC analyses were supplemented by company-level resampling, alternative specifications, nonresponse bounds and tie-corrected Kendall concordance. Regulatory pressure, profitability and board independence form a stable linkage core; firm size, firm age and CEO education are drivers. Environmental disclosure has the greatest dependence and ranks first or jointly first in dependence in every individual matrix. Business type, profitability and auditor type receive unanimously strong direct disclosure ratings, although business type ranks tenth in system influence. Executive concordance is greater for network dependence (W = 0.892) and influence (W = 0.731) than for the disclosure-specific ordering (W = 0.402). Board size and overconfidence remain sensitive to classification choices. The contribution is to distinguish factors salient to reporting from those central to the wider system, while identifying where executive priorities converge. The findings concern perceived interdependence and support governance review rather than causal claims about disclosure quality.

KEYWORDS

Environmental disclosure; corporate governance; MICMAC; structural analysis; executive perceptions; Saudi Arabia; cement industry

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1. Introduction

Environmental reporting in cement companies raises a governance problem as well as a measurement problem. Executives must decide which environmental issues require board attention, which information systems can substantiate reported performance, and how regulatory and stakeholder expectations should influence reporting priorities. These decisions connect operational exposure with financial resources, managerial expertise and external scrutiny. The International Energy Agency's assessment of cement and concrete emphasizes the continuing challenge of reducing emissions intensity and the importance of credible, comparable emissions accounting (International Energy Agency [IEA], 2025). A reporting system that communicates environmental commitments without reliable oversight or operational evidence may therefore leave a substantial accountability gap.

Saudi Arabia provides a relevant setting for examining these relationships. The Saudi Exchange introduced ESG Disclosure Guidelines in 2021 to support issuers' reporting practices, while the Capital Market Authority's Corporate Governance Regulations establish a governance framework concerned with shareholder and stakeholder rights (Saudi Exchange, 2021; Capital Market Authority [CMA], 2023). These institutional developments provide a context for studying executive perceptions at the end of September 2026. They do not, by themselves, establish that every environmental disclosure item is legally mandatory or that reporting practices have improved uniformly across companies.

The empirical literature identifies several governance and organizational correlates of sustainability reporting. However, both the outcome being measured and the institutional setting affect the findings. Research on environmental disclosure, aggregate ESG disclosure and environmental performance addresses related but distinct phenomena. For example, Chebbi and Ammer (2022) associate board size and independence with Saudi ESG disclosure, whereas Musa et al. (2025) emphasize expertise and female representation and report insignificant relationships for size and independence. International synthesis also presents different

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conclusions about particular board attributes (Lagasio & Cucari, 2019; Brogi & Lagasio, 2025). Such differences motivate closer examination of how managers connect these attributes to the wider reporting system.

Archival models estimate associations between observed characteristics and reporting outcomes. Their coefficients do not reveal the full network of relationships executives believe matters when they organize reporting decisions. A factor can be highly salient to environmental disclosure while exerting relatively little influence on other concepts. Conversely, a factor can be central to the organizational system without being the strongest immediate disclosure influence. Keeping these two forms of importance separate helps prevent an influence ranking from becoming an unsupported list of causal policy levers.

Taken together, this literature leaves three gaps. First, the Saudi evidence reviewed above comes from archival models that estimate separate associations between observed board or firm attributes and a reporting score, and its findings on attributes such as board size and independence are inconsistent across outcomes and samples (Al Naim & Alomair, 2024; Chebbi & Ammer, 2022; Musa et al., 2025). These models do not show how the executives responsible for reporting connect such attributes to one another and to disclosure as a single system. Second, they do not separate a factor's direct salience for environmental disclosure from its wider influence on the organizational system, the distinction drawn above. Third, none of the studies reviewed here elicits perceived interdependencies from senior executives across an attempted census of firms in one environmentally sensitive Saudi sector, or reports respondent-level agreement and classification stability alongside an aggregate map, even though Arkoh et al. (2024) identify environmentally sensitive industries and underexplored settings as continuing opportunities.

This study addresses these gaps through a structured field survey and MICMAC analysis, the cross-impact matrix multiplication approach to classifying influence and dependence. An attempted census invited all 14 Saudi listed cement companies; 13 supplied complete 15 by 15 matrices. Environmental disclosure is included as an explicit node alongside 14 governance, organizational, financial and institutional concepts. This permits the study to examine relationships directed specifically toward disclosure, disclosure's own structural position, and the wider interdependencies among the remaining concepts.

The study examines a reporting coordination problem: which conditions executives associate specifically with disclosure, which conditions organize the wider governance system, and how far executives share that ordering. Its theoretical contribution is to connect monitoring, resource provision and external expectations within a perceived reporting system. Its analytical contribution is to distinguish focal disclosure salience from system influence and to assess the agreement underlying each ranking. Its empirical contribution is a documented September 2026 map of an attempted sector census, retaining the individual responses and making classification uncertainty explicit. This combination extends the information available from a single aggregate influence map. It identifies shared and contested priorities without treating executive judgments as observations of disclosure quality or causal policy effects.

2. Conceptual background and research questions

2.1 Environmental disclosure and the scope of the evidence

Environmental disclosure concerns information communicated about environmental impacts, policies, risks, management practices and performance. This communication may provide substantive evidence or primarily symbolic reassurance. Legitimacy-oriented studies show why visible environmental events and public scrutiny can alter reporting behavior (Patten, 1992; Deegan et al., 2002). Research using more detailed disclosure measures also demonstrates the importance of distinguishing reporting content from the environmental performance it describes (Clarkson et al., 2008). The present study examines the perceived structure surrounding disclosure; it does not score the content of annual or sustainability reports.

This distinction also applies to previous studies. Aggregate ESG measures combine environmental, social and governance information, while environmental performance measures concern operational outcomes. Alta'any et al. (2026) report different board relationships across the separate sustainability reporting dimensions in an international sample. Alwadani et al. (2024) examine environmental performance in Saudi Arabia and identify associations with sustainability committees, separate reports and external assurance. Their evidence supports attention to reporting infrastructure, while the current survey addresses a different outcome: executives' perceptions of influence.

Arkoh et al. (2024) synthesize research on sustainability reporting determinants and identify continuing debates alongside opportunities in environmentally sensitive industries and underexplored settings. The present design responds to that agenda by studying a specific industrial setting through structured numerical judgments. It adds an account of perceived interdependence that can be compared with, rather than substituted for, evidence from observed disclosures.

2.2 Monitoring and resource provision

Agency theory explains why information asymmetry creates a role for governance mechanisms that oversee managerial decisions (Jensen & Meckling, 1976). Environmental reporting extends the information problem because executives may have better access than outside users to operational impacts, compliance risks and reporting limitations. Board independence, leadership structure and external audit can therefore be relevant to the oversight of reporting decisions. The theory does not require every observable governance attribute to have the same effect in every institutional environment.

Resource dependence adds a complementary explanation of what boards contribute. Hillman and Dalziel (2003) integrate monitoring with the provision of expertise, advice and access to resources. Applied to environmental disclosure, this perspective

directs attention to whether governance arrangements help a company interpret reporting expectations and coordinate the evidence needed to respond. Board size may represent capacity, but a numerical increase does not establish that the additional directors provide the necessary knowledge or information access.

The reporting literature illustrates these distinctions. Rupley et al. (2012) associate environmental disclosure quality with board attributes and media attention. Lagasio and Cucari's (2019) meta-analysis finds positive disclosure associations for independence, size and female representation. Brogi and Lagasio (2025), using a later synthesis, report positive associations for size and female representation but no significant effect of independent directors. A carbon-disclosure synthesis further identifies regulatory setting and disclosure measurement as sources of variation in governance associations (Hegazy et al., 2026). This evidence supports examining how oversight is embedded in reporting capacity and external expectations.

2.3 Stakeholder demands and institutional legitimacy

Stakeholder theory treats corporate decisions as embedded in relationships with groups that can affect, or be affected by, the firm (Freeman, 1984). In cement production, environmental reporting can matter to investors, regulators and communities as well as to those responsible for the firm's operating activities. Legitimacy theory explains the incentive to demonstrate that corporate conduct is compatible with prevailing expectations (Suchman, 1995). These perspectives connect firm visibility and operational exposure with external pressure for credible information.

The relevance of business type, firm size and location follows from these relationships. Earlier evidence links environmental reporting to industry and country conditions (Halme & Huse, 1997). Reverte (2009) identifies size, environmentally sensitive industries and media visibility as relevant to CSR disclosure ratings, while Welbeck et al. (2017) examine firm and industry characteristics in environmental reporting. Their settings and outcome measures differ from those of the current survey, so they establish conceptual relevance rather than an expected Saudi cement coefficient.

Within this study, business type refers to the nature and environmental exposure of operations as perceived by executives within the cement sector. It is not an archival comparison between cement and other industries. Likewise, geographical location denotes perceived contextual exposure, and firm age denotes perceived organizational maturity. These definitions avoid interpreting a concept's position in the map as evidence of measured variation across companies. The sector's shared environmental exposure may make business type particularly salient to disclosure even if its links with other governance concepts are relatively weak.

Regulatory pressure is included as a perception of legislative, supervisory and compliance expectations. The Saudi Exchange guidelines and CMA framework provide institutional context, while Chebbi and Ammer (2022) offer empirical evidence that governance reforms can condition disclosure relationships. A high regulatory influence score would indicate executives' perceived centrality of these expectations.

2.4 Executive cognition and financial reporting capacity

Upper echelons theory connects managerial background with how executives interpret strategic choices (Hambrick & Mason, 1984). CEO education is therefore retained as a concept relevant to processing complex reporting demands. Saudi evidence relating audit-chair accounting expertise to ESG disclosure provides a related argument for governance knowledge, although audit-chair expertise and CEO educational qualifications are different constructs (Fayad et al., 2024). CEO overconfidence is also retained because excessive confidence can affect managerial judgment. Malmendier and Tate (2005) demonstrate its relevance to corporate investment; that evidence does not establish a direct environmental disclosure effect.

Profitability and the concept of economic performance and growth represent related but separate ideas. Profitability concerns the capacity to generate earnings, while economic performance and growth encompass a broader perceived operating and development context. The survey did not collect return on assets, sales growth or other archival proxies. It asks executives to assess the influence of the concepts. Al-Tuwaijri et al. (2004) examine interrelations among environmental disclosure, environmental performance and economic performance. Qiu et al. (2016), however, find no relationship between environmental disclosure and profitability in their UK setting. This evidence makes a simple universal profitability prediction inappropriate.

Auditor type represents perceived differences in the external financial audit provider. Fernandez-Feijoo et al. (2018) associate Big Four financial auditors with sustainability disclosure and assurance practices. That connection motivates the concept's inclusion, but financial audit and sustainability assurance remain separate services. The current matrix contains an auditor-type node and does not independently measure whether a company purchases environmental assurance. Any interpretation of assurance credibility must therefore be framed as a possible complementary mechanism.

2.5 A structural approach to the research questions

The framework brings the preceding theories together through the coordination of environmental information. Agency theory explains the demand for scrutiny where executives and outside users have unequal access to operational evidence. Resource dependence explains why that scrutiny requires expertise, information access and organizational capacity. Stakeholder and legitimacy perspectives explain why the reporting task receives attention and which external expectations executives consider relevant. Upper echelons theory locates the interpretation of those demands in executive experience and knowledge. Each perspective therefore addresses a different part of the same reporting process.

The framework implies that oversight can be perceived as important while remaining connected to the resources and expectations needed to exercise it. A linkage position for independence, profitability or regulatory pressure would be compatible with this embedded interpretation: the concept is perceived both to influence and to depend on the wider system. A driver position for organizational scale, maturity or executive education would describe an input condition with comparatively greater outward influence. These are interpretations of unsigned network positions. Complementarity is a theoretical reading of their connected roles, rather than an estimated interaction effect or a demonstrated benefit of changing a board attribute.

The analysis distinguishes two forms of importance. Disclosure-specific salience concerns the rating of a concept's direct link to environmental disclosure. System influence concerns its outgoing links to all concepts. Operational exposure may be highly relevant to what is reported while having less influence on board composition, executive characteristics or reporting resources. This distinction is particularly useful in a single industry, where business type denotes perceived operational and environmental exposure within cement production.

Cognitive mapping makes the perceived relationships explicit, and MICMAC summarizes influence and dependence within that elicited network (Özesmi & Özesmi, 2004; Jetter & Kok, 2014; Godet, 1986, 2000). Individual rankings provide an additional check on whether the aggregate reflects common priorities. Agreement, numerical convergence and classification retention answer different questions: executives can agree on broad dependence patterns while differing over the ordering of direct reporting influences.

Three research questions organize the analysis. RQ1 asks how the 15 concepts are positioned in the direct and indirect influence-dependence structure, including environmental disclosure. RQ2 asks which concepts are most salient directly to disclosure and whether that ordering coincides with system influence. RQ3 asks how far individual executive rankings agree and how stable the aggregate classifications are to company removal, resampling, aggregation, respondent role and treatment of the disclosure node. The survey supports these structural and comparative questions. It supplies influence strength without effect direction or an independently measured reporting outcome.

3. Research design and analytical procedures

3.1 Setting and respondent selection

The field survey was conducted at the end of September 2026 in the Saudi listed cement sector. Participation was voluntary, and informed consent was obtained from each participating executive (see Declarations, Research ethics).

The study used an attempted census of the 14 Saudi cement companies listed on the Main Market of the Saudi Exchange, with all 14 companies invited to participate. The official Main Market issuer listing provides the sectoral context for the population frame (Saudi Exchange, n.d.). Thirteen companies each supplied a completed matrix, and one did not respond, giving a company-level response rate of 92.86%. The primary analysis uses the 13 observed responses without imputing the nonresponding company. The intended full-population coverage should be distinguished from complete response: nonresponse can still affect the findings. Reporting the target population, invitation denominator and completed responses separately follows survey disclosure principles (American Association for Public Opinion Research [AAPOR], 2021).

A senior executive informant was sought from each company. The CFO was the primary respondent role, with the CEO serving as the alternative senior executive respondent. The completed matrices identify nine CFOs and four CEOs. This selection seeks informed judgments about reporting, financial resources, oversight and compliance. One response per company remains an informant perspective rather than evidence that all executives or board members in that company share the same view.

Companies are identified by anonymous serial codes in the analytical dataset. No names, financial accounts or identifiable executive characteristics are used in the structural calculations.

Table 1 gives analytical interpretations of the 15 concepts and distinguishes organizational attributes from perceptions of their influence. Business type refers to operational and environmental exposure within the sector; CEO education concerns educational background; and overconfidence concerns perceived excessive executive confidence. The matrices do not establish differences in plant technology, qualifications or psychological traits between companies. These concepts are not validated multi-item scales. The common concept set and rating instructions support comparison of judgments, while construct validity remains separate from respondent agreement.

Table 1. Concepts and analytical interpretation

No.	Code	Concept	Interpretation
1	FZ	Firm size	Organizational scale, visibility and resources as perceived by the informant.
2	GL	Geographical location	Operating location and exposure to local environmental and stakeholder conditions.
3	FA	Firm age	Organizational maturity and experience associated with years of operation.
4	EPG	Economic performance and growth	Overall economic development and operating performance beyond earnings alone.
5	BT	Type of business	Nature and environmental exposure of operations within the cement sector.
6	BZ	Board size	Number of board members and the associated oversight capacity.
7	BI	Board independence	Independence of directors and their perceived monitoring role.
8	CEOD	CEO duality	Combination of the chief executive and board chair roles.
9	GD	Gender diversity	Gender representation in the board and its perceived governance role.
10	OVERCON	CEO overconfidence	Perceived influence of excessive executive confidence on organizational decisions.
11	CEOED	CEO educational qualification	CEO educational background and its perceived interpretive relevance.
12	PROFIT	Profitability	Earnings capacity and perceived financial resources available for reporting.
13	AUDITTYPE	Auditor type	Category of external financial auditor; sustainability assurance is a separate service.
14	LIGIS	Legislative and regulatory pressure	Perceived legislative, supervisory and compliance expectations.
15	ED	Environmental disclosure	Communication of environmental impacts, policies, risks, management practices and performance.

3.2 Instrument and data validation

The bilingual instrument specifies that a row concept influences a column concept. Respondents assign 0 for no influence, 1 for weak influence, 2 for moderate influence and 3 for strong influence. Fifteen diagonal cells are fixed at zero, leaving 210 directed

judgments in each matrix. The questionnaire contains no negative-effect score and no potential-influence category. Consequently, a strong score denotes perceived influence strength, not a beneficial or harmful effect. The questionnaire was distributed electronically, and completed matrices were returned electronically.

All 13 matrices were checked for dimensions, matching row and column labels, completeness, scale compliance and zero diagonals. Worksheet layouts differed in where the matrix was located, so extraction used the labeled matrix header rather than a fixed cell range. The final dataset contains 2,730 observed off-diagonal ratings and 195 fixed diagonal entries. There are no missing off-diagonal responses, out-of-scale entries or duplicated complete matrices. The unit of evidence for resampling is the company matrix. The 2,730 ratings are not treated as independent company observations.

The matrix entries measure perceptions of relationships. They do not constitute observations of actual environmental disclosure levels, board composition or executive psychological traits. No internal-consistency coefficient is reported because the dyadic ratings are distinct relationships within a network, rather than interchangeable items intended to measure one reflective construct. Table A1 in Appendix A presents the mean influence matrix for the 13 responding companies.

3.3 Aggregation and disclosure-specific ratings

Each company's matrix is denoted by A with a company superscript. All companies receive equal weight in the primary aggregate. The mean matrix M is calculated element by element as shown in Equation 1. Unrounded means are retained throughout the calculations. Rounding is applied only to displayed values, except in the separately labeled integer-rounding sensitivity analysis.

$$m_{ij} = \frac{1}{13}\sum_{r=1}^{13} a_{ij}^{(r)}, \quad m_{ii} = 0. \quad (1)$$

The environmental disclosure column is also analyzed separately. For each of its 14 incoming links, the mean, sample standard deviation, median and number of strong ratings are reported. These summaries answer RQ2 directly. Their meaning differs from the influence of a concept across the entire network, which includes its relationships with every other node. Displayed score rankings use the minimum occupied rank for ties. The concordance analysis in Section 3.7 uses average ranks and a tie correction.

3.4 Direct MICMAC classification

Direct influence is the row sum of M; direct dependence is its column sum. Equation 2 defines these measures and the common threshold, equal to total matrix weight divided by the number of nodes. The map places dependence on the horizontal axis and influence on the vertical axis.

$$I_i = \sum_{j=1}^{15} m_{ij}, \quad D_i = \sum_{j=1}^{15} m_{ji}, \quad \bar{I} = \bar{D} = \frac{1}{15}\sum_{i,j} m_{ij}. \quad (2)$$

A driver has influence at or above the threshold and dependence below it. A linkage variable is at or above both thresholds. A dependent variable is below the influence threshold and at or above the dependence threshold. An autonomous variable falls below both thresholds. The term autonomous denotes relative position within this selected network and does not imply that the variable is unimportant or should be excluded from environmental reporting decisions. The common mean threshold is a transparent analytical convention, not an empirically discovered discontinuity.

3.5 Indirect influence and computational convergence

Successive powers of the aggregate matrix trace weighted multi-step walks through the network. This process includes feedback through other nodes and distinguishes indirect structural salience from immediate links. The calculations were implemented in Python using the MICMAC matrix-power logic, with a global normalization after each multiplication to prevent numerical overflow. Equation 3 expresses the normalized recurrence and influence and dependence shares. Global normalization changes neither relative rankings nor quadrant assignments. Induced diagonal entries in higher powers are retained because they represent returning walks.

$$P_1 = \frac{M}{\sum_{i,j} m_{ij}}, \quad P_k = \frac{P_{k-1}M}{\sum_{i,j}(P_{k-1}M)_{ij}}, \quad (3)$$

$$I_i^{(k)} = 100\sum_j (P_k)_{ij}, \quad D_i^{(k)} = 100\sum_j (P_k)_{ji}.$$

The normalized influence and dependence shares each sum to 100%, giving a mean quadrant threshold of 100 divided by 15, or 6.6667%. Convergence requires unchanged influence and dependence rankings and a maximum absolute change below 10 to the power of minus eight in the unscaled shares for two consecutive transitions. A limit of 100 powers was specified. The aggregate converged at power 12. Computational convergence concerns this matrix procedure; it is not respondent agreement, a calendar time horizon or evidence that real reporting behavior has reached equilibrium. The aggregate matrix is almost fully dense, with

209 of 210 off-diagonal means positive. Density alone does not guarantee agreement between direct and indirect rankings or quadrants; cross-impact research shows that classifications can change when indirect paths are incorporated (Jodlbauer et al., 2022).

Because the ratings are unsigned, matrix powers describe the propagation of perceived influence strength. They do not estimate signed causal pathways, intervention effects or the size of a future improvement in disclosure. Positive entries into firm age or geographical location should similarly be understood as executives' perceived connections with organizational context; the map cannot imply that reporting decisions change chronological age or historical location.

3.6 Stability and specification analyses

The stability assessment addresses distinct sources of uncertainty. First, each company is removed in turn and the complete mean matrix, thresholds and classifications are recalculated. The retained-quadrant count ranges from zero to 13. Second, 10,000 bootstrap samples draw 13 complete company matrices with replacement, using seed 202601. The direct and indirect classifications are recalculated within each sample. Bootstrap proportions indicate how often a node occupies each quadrant under resampling of the responding companies. They are conditional stability summaries, not population confidence levels or hypothesis-test p-values. Bootstrap indirect powers were evaluated through power 40 and checked against a further multiplication.

Median aggregation and nearest-integer rounding examine dependence on the quasi-interval interpretation of the ordinal scores. Separate CFO and CEO maps explore informant-role sensitivity, and a role-balanced map assigns one-half weight to each role-group mean. The latter is a comparison specification; it does not replace equal company weights in the primary analysis. The small, purposively selected role groups do not support a generalizable test of CFO versus CEO differences.

Two network specifications examine the role of the outcome node. A terminal-disclosure specification sets only ED's outgoing row to zero while retaining its incoming links. A 14-node subnetwork removes ED entirely. Both specifications are analytical alternatives, not corrections to observed responses. In each, thresholds are recomputed for the resulting matrix. They test whether the leading governance positions depend on treating disclosure as a feedback participant.

Finally, a bounds analysis allows the missing company's off-diagonal ratings to take any permitted value from zero to three. For each node, bounds are derived for its centered direct influence and dependence after adding a fourteenth matrix. Appendix C gives the calculation. This check addresses a source of uncertainty that resampling the 13 respondents cannot represent. It evaluates direct classifications only.

3.7 Agreement among executive rankings

Agreement among the individual executives was evaluated using Kendall's coefficient of concordance, with average ranks and an explicit correction for ties (Kendall & Babington Smith, 1939; Legendre, 2005). Each executive supplies three rankings from their own matrix: one based on the 15 row sums for direct influence, one based on the 15 column sums for direct dependence, and one based on the 14 incoming ratings in the disclosure column. The fixed ED self-rating is excluded from the third ranking. This procedure preserves the company as the unit of evidence and compares orderings without requiring equal absolute rating intensity across informants.

Equation 4 gives the tie-corrected coefficient. Here, m is the number of executives and k the number of ranked concepts. S is the sum of squared deviations of the concept rank sums from their common expected sum, m(k + 1)/2. Each respondent's tie correction is obtained by summing the cubed size minus the size of every tied group. Higher W indicates greater concordance, with one representing identical nonconstant rankings. The coefficient is reported descriptively, without categorical cutoffs or population hypothesis tests.

$$W = \frac{12S}{m^2(k^3 - k) - m\sum_{s=1}^{m} T_s}. \quad (4)$$

For each coefficient, 10,000 resamples of the 13 complete company matrices provide a 95% percentile interval, using seed 20261003. Removing each company in turn gives an additional range. These procedures assess agreement conditional on the responding companies; they do not increase the number of independent informants or establish sector coverage. The scalar concordance formula was independently checked against the tie-corrected Friedman statistic divided by the product of the respondent count and one less than the number of concepts. Vectorized bootstrap calculations were also checked against the scalar formula. Ranking ties are retained rather than broken arbitrarily.

4. Results

4.1 Response completeness and matrix characteristics

Table 2 summarizes the sample and rating structure. Weak influence is the most frequent individual rating, accounting for 37.22% of the 2,730 elicited dyads. Moderate ratings account for 27.62%, strong ratings for 17.47%, and zero influence for 17.69%. The aggregate contains 209 positive off-diagonal means out of 210 possible relationships, a fill rate of 99.52%. This dense mean map does not mean that every respondent perceived nearly every relationship: 483 individual off-diagonal ratings were zero.

Table 2. Sample and rating structure

Characteristic	Value
Invitation frame	14 companies
Complete responses	13 companies (92.86%)
Informant roles	9 CFOs; 4 CEOs
Fieldwork timing	End of September 2026
Rated concepts	15
Elicited dyads per company	210
Observed off-diagonal ratings	2,730
Fixed diagonal entries	195
Zero influence ratings	483 (17.69%)
Weak influence ratings	1,016 (37.22%)
Moderate influence ratings	754 (27.62%)
Strong influence ratings	477 (17.47%)
Positive mean dyads	209 of 210 (99.52%)
Unanimous dyads	7 of 210
Mean dyad sample SD	0.568
Mean modal-rating share	67.69%

Note. Percentages for the four rating categories use the 2,730 off-diagonal ratings. Each of the 13 responding companies contributed 210 ratings.

The average sample standard deviation across the 210 dyads is 0.568, and seven dyads are unanimous. The average share choosing the modal rating within a dyad is 67.69%. These descriptive summaries show why retaining respondent variation matters. Matrix density, convergence and agreement measure different properties, and none is used as a substitute for the others.

4.2 Direct influence and dependence

The aggregate's total influence weight is 304.2308, exactly matching the total dependence weight. Its direct mean threshold is 20.2821. Table 3 and Figure 1 present the resulting structure. Legislative and regulatory pressure has the largest row sum, 26.00, followed by profitability at 24.46, board independence at 24.31 and firm size at 24.00. Environmental disclosure has the largest column sum, 36.69, followed by profitability at 28.31. Economic performance and growth and regulatory pressure each have dependence of 25.15.

Table 3. Direct MICMAC scores and classifications

Code	Influence	Influence rank	Dependence	Dependence rank	Quadrant
FZ	24.00	4	16.85	10	Driver
GL	11.46	15	8.77	15	Autonomous
FA	22.38	5	10.31	14	Driver
EPG	18.54	11	25.15	3	Dependent
BT	18.77	10	16.00	12	Autonomous
BZ	20.15	8	22.00	6	Dependent
BI	24.31	3	21.54	7	Linkage
CEOD	18.54	11	18.85	9	Autonomous
GD	14.46	14	14.54	13	Autonomous
OVERCON	19.77	9	19.00	8	Autonomous
CEOED	21.23	7	16.15	11	Driver
PROFIT	24.46	2	28.31	2	Linkage
AUDITTYPE	21.85	6	24.92	5	Linkage
LIGIS	26.00	1	25.15	3	Linkage
ED	18.31	13	36.69	1	Dependent

Note. Influence is the row sum and dependence is the column sum of the unrounded mean matrix. Both axes use a threshold of 20.2821. Ties receive the lowest numerical rank in the tied group.

Four nodes occupy the linkage quadrant: board independence, profitability, auditor type, and legislative and regulatory pressure. Each combines above-threshold influence and dependence. These positions describe an interconnected cluster rather than four exogenous policy instruments. Three nodes occupy the driver quadrant: firm size, firm age and CEO educational qualification. Economic performance and growth, board size and environmental disclosure are dependent. The five autonomous nodes are geographical location, business type, CEO duality, gender diversity and CEO overconfidence.

Board size lies close to the influence boundary. Its row sum of 20.15 is only 0.13 below the threshold, despite a dependence score of 22.00. CEO overconfidence is also near the boundary, with influence of 19.77 and dependence of 19.00. Their numerical proximity warrants more qualified interpretation than would be suggested by assigning each a single categorical label without a sensitivity assessment. Auditor type is also less secure than the other linkage nodes: its influence of 21.85 exceeds the threshold by 1.57, whereas the other three linkage nodes exceed it by at least 4.03.

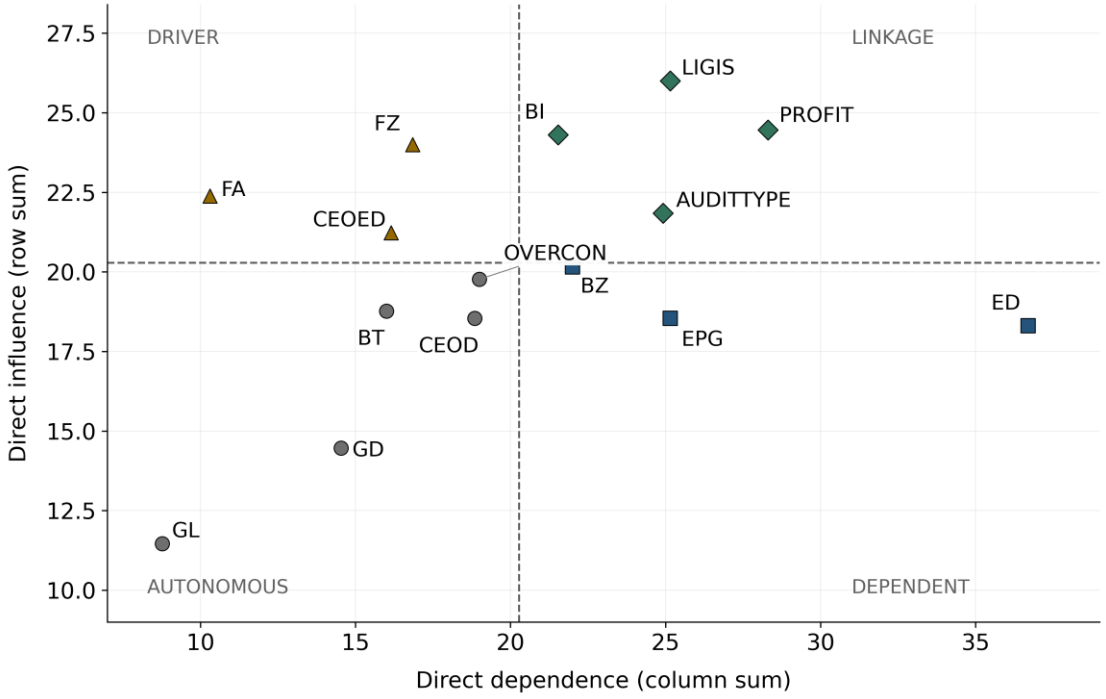

Figure 1. Direct influence and dependence map

Note. Codes are defined in Table 1. Dashed lines are the mean influence and dependence thresholds. Scores use the unrounded mean matrix.

4.3 Direct influences specifically on environmental disclosure

Table 4 isolates the environmental disclosure column and places each link's ranking beside its source node's system-wide influence rank. Business type, profitability and auditor type each receive a mean score of 3.00, with all 13 executives selecting strong influence. Board independence and CEO educational qualification each average 2.92, regulatory pressure averages 2.85, and firm size averages 2.77. Gender diversity receives the lowest mean in this column, 2.08, but ten respondents still assign moderate or strong influence.

Table 4. Perceived direct influences on environmental disclosure

Source	Mean	Sample SD	Median	Strong ratings	ED-link rank	System influence rank
BT	3.00	0.000	3	13/13	1	10
PROFIT	3.00	0.000	3	13/13	1	2
AUDITTYPE	3.00	0.000	3	13/13	1	6
BI	2.92	0.277	3	12/13	4	3
CEOED	2.92	0.277	3	12/13	4	7
LIGIS	2.85	0.376	3	11/13	6	1
FZ	2.77	0.439	3	10/13	7	4
FA	2.62	0.506	3	8/13	8	5
GL	2.38	0.506	2	5/13	9	15
BZ	2.38	0.650	2	6/13	9	8
OVERCON	2.31	0.480	2	4/13	11	9
EPG	2.23	0.599	2	4/13	12	11
CEOD	2.23	0.599	2	4/13	12	11
GD	2.08	0.760	2	4/13	14	14

Note. Ratings range from 0 (none) to 3 (strong). ED-link rank uses the mean rating for the link to environmental disclosure. System influence rank uses the sum of all outgoing links. Ties receive the lowest numerical rank in the tied group.

Business type illustrates the distinction addressed by RQ2. It is jointly first for its direct disclosure link but tenth in system-wide direct influence and lies in the autonomous quadrant. Geographical location is fifteenth in system-wide influence but has a disclosure-link mean of 2.38. Thus, comparatively low network centrality does not imply a weak direct relationship with the focal reporting concept. A disclosure-specific priority list and an organization-wide centrality map answer different questions.

The environmental disclosure row also contains nonzero perceived feedback, including links to profitability of 2.31, regulatory pressure of 2.08, and links to both economic performance and growth and auditor type of 2.00 each. These entries justify evaluating the feedback specification explicitly. They can reflect perceived reputational, reporting-demand or resource connections.

4.4 Indirect structure and classification stability

At the converged twelfth power, environmental disclosure retains the largest dependence share, 11.33%, while regulatory pressure has the largest influence share, 8.22%. Profitability, board independence and firm size have influence shares of 7.83%, 7.82% and 7.80%, respectively. Figure 2 and Table 5 show the full indirect classification. All 15 primary quadrant assignments match those of the direct map. Direct and indirect rank correlations are 0.996 for influence and 0.988 for dependence, reported as descriptive rank agreement rather than inferential tests. This close agreement is an observed feature of the present data, rather than a consequence guaranteed by matrix density. Because both maps are derived from the same elicited matrix, their agreement provides an internal structural comparison, not independent empirical validation (Jodlbauer et al., 2022).

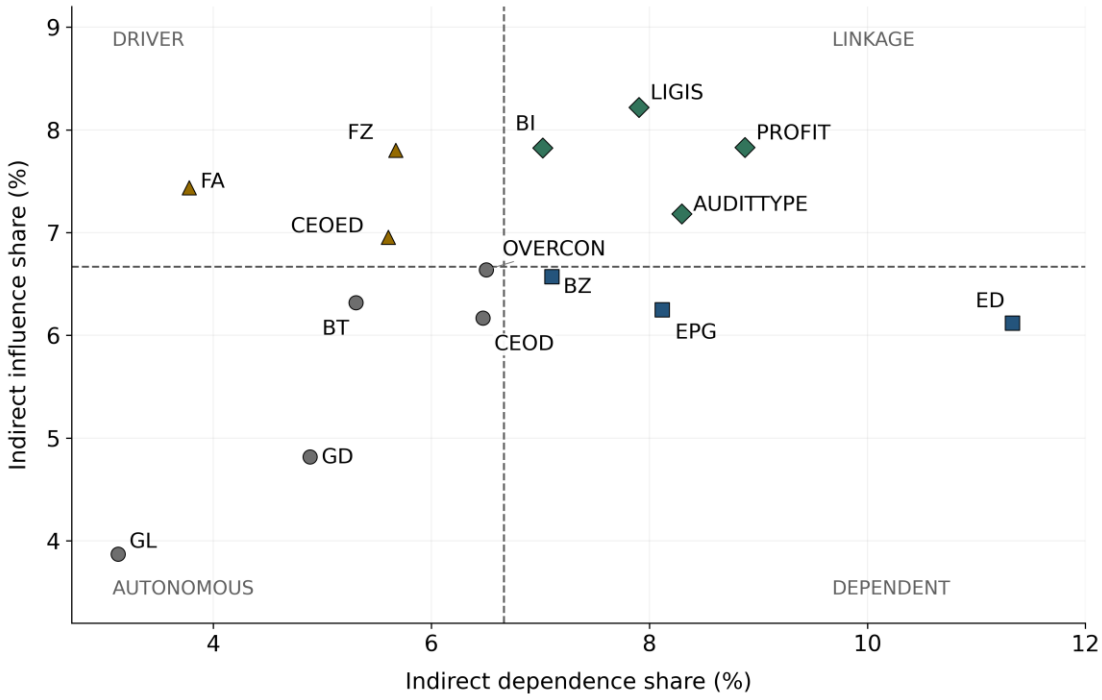

Figure 2. Indirect influence and dependence map

Note. Codes are defined in Table 1. Dashed lines are the mean influence and dependence thresholds. Shares use the converged twelfth matrix power.

Table 5. Indirect MICMAC shares and classification stability

Code	Influence (%)	Dependence (%)	Quadrant	Direct bootstrap (%)	Indirect bootstrap (%)	Direct LOO	Indirect LOO
FZ	7.80	5.67	Driver	100.0	100.0	13/13	13/13
GL	3.87	3.13	Autonomous	100.0	100.0	13/13	13/13
FA	7.44	3.78	Driver	100.0	100.0	13/13	13/13
EPG	6.25	8.12	Dependent	100.0	99.8	13/13	13/13
BT	6.32	5.31	Autonomous	99.5	96.3	13/13	13/13
BZ	6.57	7.11	Dependent	57.5	65.8	9/13	13/13
BI	7.82	7.02	Linkage	98.5	96.0	13/13	13/13
CEOD	6.17	6.47	Autonomous	98.7	84.2	13/13	13/13
GD	4.82	4.89	Autonomous	100.0	100.0	13/13	13/13

Code	Influence (%)	Dependence (%)	Quadrant	Direct bootstrap (%)	Indirect bootstrap (%)	Direct LOO	Indirect LOO
OVERCON	6.64	6.50	Autonomous	77.2	40.6	13/13	9/13
CEOED	6.96	5.61	Driver	97.4	96.2	13/13	13/13
PROFIT	7.83	8.88	Linkage	100.0	100.0	13/13	13/13
AUDITTYPE	7.18	8.30	Linkage	98.8	99.5	13/13	13/13
LIGIS	8.22	7.90	Linkage	100.0	100.0	13/13	13/13
ED	6.12	11.33	Dependent	100.0	100.0	13/13	13/13

Note. Influence and dependence are percentage shares at power 12. The threshold on each axis is 6.6667%. Bootstrap columns give the percentage of 10,000 company-level resamples retaining the primary quadrant. Leave-one-out (LOO) columns give the number of omissions retaining that quadrant, out of 13.

Matching aggregate classifications can conceal important differences in stability. Direct bootstrap retention is at least 97.4% for 13 of the 15 nodes. Board size retains its dependent classification in 57.5% of direct samples and is classified as linkage in 42.0%. CEO overconfidence retains autonomous status in 77.2% and is a driver in 21.9%. The indirect map is more sensitive for overconfidence: autonomous, driver, dependent and linkage proportions are 40.6%, 39.5%, 14.9% and 5.1%, respectively. CEO duality's indirect autonomous retention is 84.2%, providing a further reason to avoid treating all labels as equally secure.

Leave-one-company-out analysis retains every direct classification in all 13 removals except board size, whose dependent position is retained in nine. Every indirect classification is retained in all 13 removals except CEO overconfidence, whose autonomous position is retained in nine. Board size's indirect leave-one-out stability does not contradict its bootstrap sensitivity: omission of one respondent and repeated resampling of respondents produce different perturbations.

4.5 Alternative specifications and the missing company

Table 6 summarizes agreement with the primary map, while Appendix B supplies the full classifications. Median aggregation changes the direct position of CEO overconfidence and the indirect positions of overconfidence and CEO duality. Integer rounding changes the auditor-type classification and, indirectly, CEO overconfidence. This sensitivity supports retaining unrounded means as the primary representation rather than discretizing them before classification.

Table 6. Agreement with the primary classification under alternative specifications

Specification	Direct match	Indirect match	Changed direct positions	Changed indirect positions
Median aggregation	14/15	13/15	OVERCON Driver	CEOD Dependent; OVERCON Linkage
Integer rounding	14/15	13/15	AUDITTYPE Dependent	OVERCON Dependent; AUDITTYPE Dependent
CFO only (n = 9)	15/15	14/15	None	OVERCON Dependent
CEO only (n = 4)	12/15	10/15	BZ Linkage; OVERCON Driver; AUDITTYPE Dependent	EPG Linkage; BZ Linkage; CEOD Driver; OVERCON Driver; AUDITTYPE Dependent
Equal role-group weights	13/15	13/15	BZ Linkage; OVERCON Driver	BZ Linkage; OVERCON Driver
ED as terminal node	13/15	12/15	BZ Linkage; OVERCON Driver	EPG Linkage; BZ Linkage; OVERCON Driver
14-node subnetwork	13/14	12/14	OVERCON Dependent	CEOD Dependent; OVERCON Linkage

Note. A match means that a concept retains its primary quadrant. The denominator is 15 concepts, or 14 when environmental disclosure (ED) is excluded. Tables B2 and B3 list the quadrant for each concept.

The role-balanced map changes board size to linkage and overconfidence to driver. The separate CEO map also differs for auditor type, and some indirect positions differ for both economic performance and growth and CEO duality. These differences demonstrate specification sensitivity; they cannot be attributed uniquely to role because role and company are confounded and the CEO group contains only four informants. The core positions of regulatory pressure, profitability and board independence as

linkage variables, and firm size, firm age and CEO education as drivers, persist across all seven alternative specifications in both direct and indirect analyses. Auditor type remains a linkage node in the primary map, in all 13 leave-one-out runs and in at least 98.8% of bootstrap samples, but it becomes dependent under integer rounding and in the four-executive CEO map; because its influence margin over the threshold is narrow, it is not included in the core. Business type remains autonomous throughout.

Making disclosure a terminal node preserves the core linkage and driver positions but changes board size and overconfidence in the direct map and also economic performance and growth in the indirect map. Removing ED from the network preserves the same core positions while changing overconfidence and, indirectly, CEO duality. These comparisons show which conclusions extend beyond a particular treatment of disclosure feedback.

The missing-response bounds guarantee the primary direct quadrant for five nodes under every permitted additional matrix: firm size, geographical location, gender diversity, profitability and regulatory pressure. The other ten cannot be guaranteed under unrestricted worst-case scores. Nevertheless, environmental disclosure remains the most dependent node for every possible fourteenth response. Its observed dependence lead over the next-ranked node corresponds to 109 rating units across the 13 original matrices, exceeding the maximum 42-unit advantage that the missing matrix could give another node. This is a direct-score result; it does not establish an equivalent worst-case guarantee for indirect rankings.

4.6 Shared dependence patterns and differing disclosure priorities

Table 7 separates executive agreement from aggregate classification stability. Concordance is 0.892 for the ordering of network dependence, with a 95% respondent-resampling interval of 0.876 to 0.926. Influence concordance is 0.731, with an interval of 0.680 to 0.837. Direct disclosure-rating concordance is 0.402, with an interval of 0.302 to 0.599. The corresponding company-removal ranges remain 0.887 to 0.904, 0.716 to 0.760 and 0.375 to 0.452. Each network score sums 14 off-diagonal ratings. Each disclosure link receives a single four-point rating from each executive. The coarser disclosure scale produces more ties and may partly explain the lower concordance.

Table 7. Concordance among the thirteen executive rankings

Ranking assessed	Concepts	Kendall W	95% resampling interval	Leave one out range
Influence across the network	15	0.731	0.680 to 0.837	0.716 to 0.760
Dependence across the network	15	0.892	0.876 to 0.926	0.887 to 0.904
Direct influences on disclosure	14	0.402	0.302 to 0.599	0.375 to 0.452

Note. Kendall's W uses average ranks with a correction for ties. The 95% intervals are the 2.5th and 97.5th percentiles of 10,000 resamples of complete company matrices. The final column gives the range of W when each company is omitted in turn.

Environmental disclosure has the greatest direct dependence in every individual matrix: it is uniquely first in 12 companies and jointly first in one. Its aggregate position therefore reflects a shared ordering rather than an effect created by averaging dissimilar dependence rankings. The result adds respondent-level support to the aggregate ranking and the worst-case missing-response bound.

The lower concordance for direct disclosure ratings qualifies the interpretation of Table 4. All executives give the maximum rating to business type, profitability and auditor type, yet the complete ordering of the other influences is less consistently shared. High mean ratings and agreement about selected top links can coexist with differences over the remaining priorities. The evidence supports a common perception that reporting depends on organizational and external conditions, while allowing more company-specific judgments about their relative disclosure importance.

5. Discussion

5.1 Environmental disclosure as an organizationally dependent outcome

The most consistent outcome-level finding is the high dependence of environmental disclosure. Its incoming score exceeds every other node in both direct and indirect analysis, and its direct lead survives the unrestricted missing-response check. Executives therefore connect disclosure with a range of organizational and external conditions. This structure is compatible with a reporting process that requires operational information, executive interpretation and governance attention to converge before an outward communication can be prepared. Ratings in the disclosure column are concentrated near the upper end of the scale. This concentration contributes to the high incoming total and warrants caution when distinguishing the relative strength of individual disclosure influences; it does not by itself demonstrate response bias or an artificially inflated dependence score.

The result extends the monitoring and resource-provision framework by locating disclosure where several reporting inputs meet. The individual matrices (Section 4.6) provide evidence of a shared perceived architecture, while the lower agreement on direct reporting priorities suggests flexibility in how companies organize their response. Clarkson et al. (2008) examine observed disclosure and environmental performance; the present map addresses the organization of perceived reporting influences.

Together, the two types of evidence distinguish the conditions managers consider necessary from the information a company ultimately publishes.

Disclosure dependence also has a practical implication. Assigning reporting responsibility to a finance or sustainability function may be insufficient if that function cannot obtain environmental data or secure governance oversight. The evidence identifies a perceived coordination need.

5.2 Regulatory pressure, profitability and audit as jointly salient conditions

Regulatory pressure leads the influence ranking and occupies the linkage quadrant, together with profitability and auditor type. The regulatory result is consistent with the relevance of institutional expectations in the Saudi reporting setting and the reform-related evidence of Chebbi and Ammer (2022). Its dependence position additionally indicates that executives perceive those expectations as connected to business and reporting conditions.

Profitability's linkage position and unanimously strong disclosure rating indicate perceived financial salience. They do not resolve the competing empirical findings in the literature. Al-Tuwaijri et al. (2004) identify interrelations among environmental and economic measures, while Qiu et al. (2016) do not find a profitability relationship for environmental disclosure. The current evidence concerns what managers regard as influential, so it can coexist with a weak association between realized profitability and realized reporting. Executives may see financial capacity as important even when the allocation of that capacity or the incentive to disclose varies.

Auditor type is also prominent both specifically for disclosure and across the system, although its linkage classification is more specification-dependent than those of regulatory pressure and profitability (Section 4.5). Fernandez-Feijoo et al. (2018) provide related international evidence on financial auditors and sustainability reporting. The current survey supports attention to the perceived reporting role of external audit providers, but it does not identify an assurance service or independently compare audit firms' work. Alwadani et al. (2024) offer evidence on external assurance and environmental performance in Saudi Arabia, which is useful as a complementary mechanism rather than a measurement equivalence.

These positions connect an external demand for information with the resources and scrutiny needed to respond. Regulatory pressure supplies the perceived reporting expectation, profitability represents perceived resource availability, and independence and audit-related salience concern oversight and credibility. This interpretation follows the integrated monitoring and resource argument of Hillman and Dalziel (2003). It is also compatible with evidence that governance-disclosure associations depend on reporting institutions and measurement (Hegazy et al., 2026). The map identifies a plausible coordination mechanism: expectations, capacity and scrutiny are considered together.

5.3 Independence and expertise compared with board size

Board independence is a linkage variable with strong disclosure-specific salience, and CEO education is a driver with a similarly strong disclosure link. These findings make oversight and interpretive capacity plausible priorities for further investigation. They are broadly compatible with monitoring and resource-provision arguments, but the scores contain no sign and therefore cannot establish that increasing either attribute would enhance disclosure.

The literature also cautions against equating independence with effective oversight in every setting. Chebbi and Ammer (2022) report a positive Saudi relationship, while Al Naim and Alomair (2024) find no significant independence relationship in their ESG study. These differences reinforce the importance of measurement and institutional context. The current BI concept is broad. Its centrality identifies an area managers regard as connected to the reporting system, providing a reason to investigate the specific oversight practices behind that perception.

CEO education's role can be interpreted through the executive cognition argument without treating a qualification as a direct measure of competence. Fayad et al. (2024) relate audit-chair accounting expertise to ESG disclosure, and Musa et al. (2025) emphasize board skills and background. These are related knowledge mechanisms, but they concern different decision makers. A useful next step would distinguish relevant environmental and accounting expertise from general educational attainment and assess whether the differences correspond to reporting outcomes.

Board size has a less secure position. Its direct influence lies only marginally below the classification threshold, and its bootstrap classification is split between dependent and linkage (Section 4.4). This matters theoretically because a headcount can represent available board capacity while remaining responsive to wider organizational conditions. Brogi and Lagasio (2025) report a positive meta-analytic size association, whereas Alta'any et al. (2026) show that relationships differ across reporting dimensions. The structural evidence supplies a possible reason for such variation: the role attributed to size depends on its connections to the wider system. The current analysis does not test that explanation across institutions, but it supports reporting the continuous score and its uncertainty rather than prescribing an optimal number of directors.

5.4 Operational salience and lower system centrality

Business type provides the clearest separation between focal reporting salience and system influence. It receives a strong disclosure rating from every executive, ranks jointly first for that link, and ranks tenth in system influence. Its autonomous classification persists across all seven alternatives. The framework explains how an operational exposure can shape the information executives believe

should be reported while having fewer perceived connections to the rest of the governance system. Halme and Huse (1997) establish the relevance of industry and country conditions to environmental reporting; this study adds an explicitly within-sector account of how reporting relevance and global network influence can diverge. A centrality ranking alone would understate this direct reporting priority.

The same distinction helps interpret location and gender diversity. Lower system centrality is a relative measure within the selected node set. Location still has a disclosure mean of 2.38 and gender diversity a mean of 2.08. Ten executives regard the latter link as at least moderate.

Gender findings in the literature reinforce this caution. Musa et al. (2025) report positive associations for female representation, while Alta'any et al. (2026) find no significant gender-diversity association across the sustainability reporting dimensions they examine. The executive map neither confirms nor rejects those associations. It records a different form of evidence and suggests that respondents perceive less broad network influence for gender diversity than for independence or regulatory pressure.

5.5 Executive agreement and classification uncertainty

CEO overconfidence is the clearest example of a classification that should remain open to interpretation. Its indirect quadrant probabilities are distributed across all four regions, and its position changes under median aggregation, role weighting and removal of the disclosure node. A single autonomous label would obscure this behavior. The appropriate conclusion is that its placement is uncertain within the current map, while its disclosure-specific influence is commonly rated moderate or strong.

This uncertainty does not contradict the behavioral finance evidence on overconfidence and investment (Malmendier & Tate, 2005). The current concept is an executive-rated influence relationship, not an independently validated overconfidence measure. Stronger investigation would combine validated behavioral proxies with interviews explaining why respondents connect overconfidence to particular reporting choices.

Concordance, bootstrap retention, specification sensitivity and numerical convergence assess different properties of the evidence (Sections 2.5 and 3.5). They prevent the stable aggregate map from being read as complete executive consensus, and they separate the well-supported reporting-dependence pattern from the less secure board-size and overconfidence labels.

6. Implications for governance and further testing

The strongest basis for governance review is the core that survives all seven alternative specifications: regulatory pressure, profitability and board independence remain linkage variables, while firm size, firm age and CEO education remain drivers. Boards can use this pattern to examine how reporting expectations are interpreted, whether the reporting function has access to operational evidence, and who challenges the information before publication. Firm age and size describe organizational context and should not be presented as readily adjustable interventions. Education directs attention to interpretive capability, without establishing that a particular qualification improves disclosure.

Disclosure-specific priorities require a second reading of the evidence. The unanimously strong links for business type, profitability and auditor type support examining whether existing reporting arrangements address operational environmental exposure, allocate reporting resources and clarify the role of external scrutiny. Business type's relatively low network centrality provides no reason to omit sector-relevant information. Auditor type is prominent in the focal ratings and retains its linkage classification under resampling and company removal, but it is specification-dependent because its influence lies close to the threshold, so the implication concerns scrutiny of the reporting process rather than a universal ranking of audit providers. Financial audit and environmental assurance must remain distinct.

Board size and overconfidence warrant qualified recommendations because their classifications are sensitive. Governance review can examine the relevant responsibilities and judgment processes instead of treating a quadrant label as an instruction to enlarge a board or infer an executive trait. The concordance results also support a common reporting framework with room for company-specific priorities: executives share the dependence structure more closely than the full ordering of direct disclosure influences. For market institutions, this suggests combining clear reporting expectations with sector-relevant implementation guidance. These are evidence-informed review priorities, not quantified gains from tested interventions.

For research, the contribution is a more discriminating account of executive perceptions. The stable dependence structure, differences between focal salience and system influence, and uneven ranking agreement define separate empirical questions. Future tests can examine whether these perceived distinctions correspond to observed reporting content and organizational practice.

7. Limitations

The evidence comprises 13 senior informants from an attempted census of the 14 Saudi listed cement companies at the end of September 2026. Although every company in the population frame was invited, the 92.86% response rate does not eliminate nonresponse bias. The missing-company bounds show that several direct classifications could change under unrestricted additional ratings, even when bootstrap retention is high. The characteristics and views of the nonresponding company remain unknown. Generalization is also limited to this sector, institutional setting and survey period.

One executive per company may not capture disagreement between finance, operations, sustainability staff and directors. Rank concordance documents agreement among the participating informants, but it cannot validate the concepts or demonstrate agreement within a company. The lower concordance for direct disclosure ratings also limits the use of a single detailed priority ordering for every firm. Anonymous company codes prevent an independent archival comparison of responding and nonresponding firms within this analytical dataset.

The 0 to 3 scale is ordinal and unsigned. Averaging assumes sufficiently comparable strength categories, while matrix multiplication compounds those encoded strengths. Median and rounding specifications partly examine that assumption but do not establish measurement invariance. The predetermined concepts also constrain what executives can express: sustainability committees, ownership structure, environmental management systems and actual assurance choices may matter but are not separate nodes. The concepts of economic performance and growth and profitability may overlap in respondents' interpretations. Documentation of translation checks and pilot testing was unavailable, limiting assessment of equivalence between the two language versions. Ratings in the disclosure column are concentrated near the upper end of the scale: thirteen of the fourteen means are at least 2.23. This leaves limited scale headroom and can constrain discrimination among highly rated disclosure influences. Shared respondent and measurement conditions are potential sources of method effects (Podsakoff et al., 2003), but neither the score concentration nor the present analysis establishes that such effects occurred.

The aggregate is dense, and long matrix walks summarize the structure encoded in that aggregate. High indirect centrality does not identify an actual transmission mechanism. Incoming links to contextual concepts such as firm age additionally require interpretive caution. Threshold-based quadrants compress continuous scores, making near-boundary assignments sensitive. The reported numerical scores and stability measures are consequently more informative than categorical labels alone.

Finally, the study lacks independently measured environmental disclosure, environmental performance and signed effects. It cannot establish whether the companies disclose well, whether particular governance practices improve that disclosure, or whether the map describes causal relationships. Its contribution is a documented executive-perception structure with transparent sensitivity analysis. Triangulation with reports, multiple informants and longitudinal evidence is required to evaluate its behavioral and policy implications.

8. Conclusion

The field survey conducted at the end of September 2026 provides a structural account of executive perceptions in 13 Saudi listed cement companies. Regulatory pressure, profitability and board independence form a consistently retained linkage core, while firm size, firm age and CEO education are drivers. Environmental disclosure has the greatest direct and indirect aggregate dependence and ranks first or jointly first in dependence in each individual matrix. Auditor type is salient to disclosure and stable under resampling, but its classification depends on aggregation and respondent-role specification; board size and overconfidence require explicit uncertainty qualifications.

The contribution is to connect the perceived reporting architecture with the priorities and agreement underlying it. Business type is unanimously important to disclosure despite its lower system influence. Executive rankings show closer concordance for network dependence than for the detailed ordering of direct reporting influences. This combination supports a shared view of reporting as a coordination task while leaving room for different company priorities. By keeping focal ratings, continuous network scores, agreement and classification stability distinct, the study supplies a more precise basis for governance review and subsequent empirical testing. The evidence remains a map of executive judgments, with observed disclosure quality and causal effects outside its measurement scope.

Declarations

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Research ethics

The Scientific Research Standing Subcommittee for Research Ethics in Theoretical and Humanities, Qassim University, approved the study on September 21, 2026 (reference 26-36-305). Participation was voluntary. All participating executives gave informed consent before completing the instrument. The analytical dataset identifies responses by company code and executive role and excludes company and participant names.

Data availability

Table A1 reports the aggregate influence matrix, with entries rounded to two decimal places. Appendix B reports convergence diagnostics and classifications under alternative specifications. Appendix C reports how the missing company's response could affect the aggregate direct scores.

Use of generative AI

Generative AI tools were used for language editing and proofreading. The author takes full responsibility for the content and accuracy of the manuscript.

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Appendix A Instrument interpretation and aggregate influence matrix

The instrument asks how strongly each row concept influences each column concept, using 0 for no influence, 1 for weak, 2 for moderate and 3 for strong influence. Self-influence is fixed at zero. The 15 concepts are listed in Table 1. Environmental disclosure is a rated concept in the network, not a content-analysis disclosure score. The entries below are arithmetic means of 13 company ratings and are displayed to two decimals; calculations use the unrounded values.

Table A1. Mean direct influence matrix

From / to	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
01 FZ	0.00	1.23	1.23	2.38	1.00	2.31	1.38	1.08	1.23	1.08	1.08	2.92	2.00	2.31	2.77
02 GL	1.00	0.00	0.08	1.00	1.85	0.15	0.38	0.08	0.31	0.15	0.38	1.54	0.15	2.00	2.38
03 FA	2.00	0.15	0.00	1.92	0.92	2.08	1.92	1.15	1.38	1.00	1.15	2.62	2.08	1.38	2.62
04 EPG	2.23	0.92	1.00	0.00	1.31	1.15	1.00	1.00	0.23	0.92	0.92	3.00	1.15	1.46	2.23
05 BT	1.00	1.08	0.38	2.23	0.00	1.31	1.08	0.08	0.00	0.23	1.00	2.38	2.00	3.00	3.00
06 BZ	1.31	0.23	1.00	1.31	1.31	0.00	2.00	2.08	1.92	1.00	1.08	1.23	2.15	1.15	2.38

From / to	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
07 BI	1.23	0.46	1.15	1.00	1.00	2.08	0.00	2.69	2.15	2.08	1.15	1.31	2.77	2.31	2.92
08 CEOD	0.31	0.23	0.23	1.23	0.31	2.38	2.23	0.00	1.00	2.92	0.46	2.31	1.31	1.38	2.23
09 GD	0.15	0.38	0.23	0.85	0.23	2.08	1.85	1.15	0.00	0.85	1.08	1.23	1.00	1.31	2.08
10 OVERCON	1.00	0.23	0.46	2.92	0.92	0.92	2.23	2.00	0.15	0.00	1.15	2.77	1.31	1.38	2.31
11 CEOED	0.77	0.38	0.38	2.92	1.08	1.08	0.77	1.38	0.92	2.08	0.00	2.23	2.00	2.31	2.92
12 PROFIT	2.54	1.08	1.38	2.85	1.23	1.31	1.15	1.31	1.23	2.15	2.23	0.00	2.15	0.85	3.00
13 AUDITTYPE	1.31	0.46	1.31	1.23	1.15	2.23	2.46	1.38	1.46	1.15	1.31	1.15	0.00	2.23	3.00
14 LIGIS	1.23	0.92	0.54	1.31	2.77	1.77	2.00	2.23	2.08	2.31	1.85	1.31	2.85	0.00	2.85
15 ED	0.77	1.00	0.92	2.00	0.92	1.15	1.08	1.23	0.46	1.08	1.31	2.31	2.00	2.08	0.00

Note. Rows identify the source concept and columns the receiving concept. Column numbers follow Table 1. Each entry is the mean of 13 company ratings, shown to two decimal places. The diagonal was fixed at zero.

Appendix B Convergence and complete alternative classifications

Rankings first stabilize at power 4. The stricter stopping rule requires unchanged rankings plus a maximum share change below the specified tolerance for two consecutive transitions. It is satisfied at power 12. This distinction separates rank convergence from the chosen numerical tolerance.

Table B1. Numerical convergence of the primary aggregate

Matrix power	Maximum share change	Ranks unchanged from preceding power
1	—	—
2	8.302e-03	No
3	1.158e-03	No
4	1.904e-04	Yes
5	3.775e-05	Yes
6	8.407e-06	Yes
7	1.837e-06	Yes
8	4.092e-07	Yes
9	9.114e-08	Yes
10	2.045e-08	Yes
11	4.590e-09	Yes
12	1.033e-09	Yes

Note. Maximum change is the largest absolute change in any influence or dependence share (0–1 scale) from the preceding power. Convergence requires unchanged rankings and a maximum change below 0.00000001 for two consecutive transitions. A dash indicates that no preceding power is available for comparison.

Table B2. Complete direct classifications

Code	Primary	Median	Rounded	CFO only	CEO only	Equal roles	ED terminal	14 nodes
FZ	D	D	D	D	D	D	D	D
GL	A	A	A	A	A	A	A	A
FA	D	D	D	D	D	D	D	D
EPG	P	P	P	P	P	P	P	P
BT	A	A	A	A	A	A	A	A
BZ	P	P	P	P	L	L	L	P
BI	L	L	L	L	L	L	L	L
CEOD	A	A	A	A	A	A	A	A
GD	A	A	A	A	A	A	A	A
OVERCON	A	D	A	A	D	D	D	P
CEOED	D	D	D	D	D	D	D	D
PROFIT	L	L	L	L	L	L	L	L

Code	Primary	Median	Rounded	CFO only	CEO only	Equal roles	ED terminal	14 nodes
AUDITTYPE	L	L	P	L	P	L	L	L
LIGIS	L	L	L	L	L	L	L	L
ED	P	P	P	P	P	P	P	—

Note. A = autonomous, P = dependent, D = driver, L = linkage. Each specification uses its own thresholds. A dash indicates that environmental disclosure (ED) is excluded.

Table B3. Complete indirect classifications

Code	Primary	Median	Rounded	CFO only	CEO only	Equal roles	ED terminal	14 nodes
FZ	D	D	D	D	D	D	D	D
GL	A	A	A	A	A	A	A	A
FA	D	D	D	D	D	D	D	D
EPG	P	P	P	P	L	P	L	P
BT	A	A	A	A	A	A	A	A
BZ	P	P	P	P	L	L	L	P
BI	L	L	L	L	L	L	L	L
CEOD	A	P	A	A	D	A	A	P
GD	A	A	A	A	A	A	A	A
OVERCON	A	L	P	P	D	D	D	L
CEOED	D	D	D	D	D	D	D	D
PROFIT	L	L	L	L	L	L	L	L
AUDITTYPE	L	L	P	L	P	L	L	L
LIGIS	L	L	L	L	L	L	L	L
ED	P	P	P	P	P	P	P	—

Note. A = autonomous, P = dependent, D = driver, L = linkage. Each specification uses its own thresholds. A dash indicates that environmental disclosure (ED) is excluded.

Appendix C Direct-score bounds for the missing fourteenth response

Let A be a valid additional matrix, with zero diagonal and off-diagonal scores from zero to three. A node's row or column total ranges from zero to 42, while the other 196 off-diagonal entries can total 588. Its contribution to the centered score (node total minus total matrix weight divided by 15) lies between −39.2 and 39.2. Given the current centered score g, the 14-response centered score lies between (13g − 39.2)/14 and (13g + 39.2)/14.

These sharp marginal bounds guarantee a quadrant only when both axes stay on their primary side of zero for every permitted missing response. They allow unrestricted scores for the absent executive and leave the observed 13-response primary matrix unchanged.

Table C1. Bounds on centered direct scores after a hypothetical fourteenth response

Code	Influence minimum	Influence maximum	Dependence minimum	Dependence maximum	Primary quadrant guaranteed
FZ	0.65	6.25	-5.99	-0.39	Yes
GL	-10.99	-5.39	-13.49	-7.89	Yes
FA	-0.85	4.75	-12.06	-6.46	No
EPG	-4.42	1.18	1.72	7.32	No
BT	-4.20	1.40	-6.78	-1.18	No
BZ	-2.92	2.68	-1.20	4.40	No
BI	0.94	6.54	-1.63	3.97	No
CEOD	-4.42	1.18	-4.13	1.47	No
GD	-8.20	-2.60	-8.13	-2.53	Yes
OVERCON	-3.28	2.32	-3.99	1.61	No
CEOED	-1.92	3.68	-6.63	-1.03	No
PROFIT	1.08	6.68	4.65	10.25	Yes

Code	Influence minimum	Influence maximum	Dependence minimum	Dependence maximum	Primary quadrant guaranteed
AUDITTYPE	-1.35	4.25	1.51	7.11	No
LIGIS	2.51	8.11	1.72	7.32	Yes
ED	-4.63	0.97	12.44	18.04	No

Note. Bounds are relative to the recalculated threshold. A score of zero lies on the upper side of the classification boundary. "Yes" indicates that both influence and dependence retain their primary classification for every admissible fourteenth response.

For the direct dependence ranking, ED exceeds PROFIT, the next-ranked node, by 109 units in the summed ratings of the original 13 matrices. A single additional matrix can change the difference between two column sums by at most 42. ED's direct lead therefore remains at least 67 divided by 14, or 4.79, in the 14-company mean. This guarantee concerns the largest direct dependence score, not ED's quadrant or indirect rank under every hypothetical response.