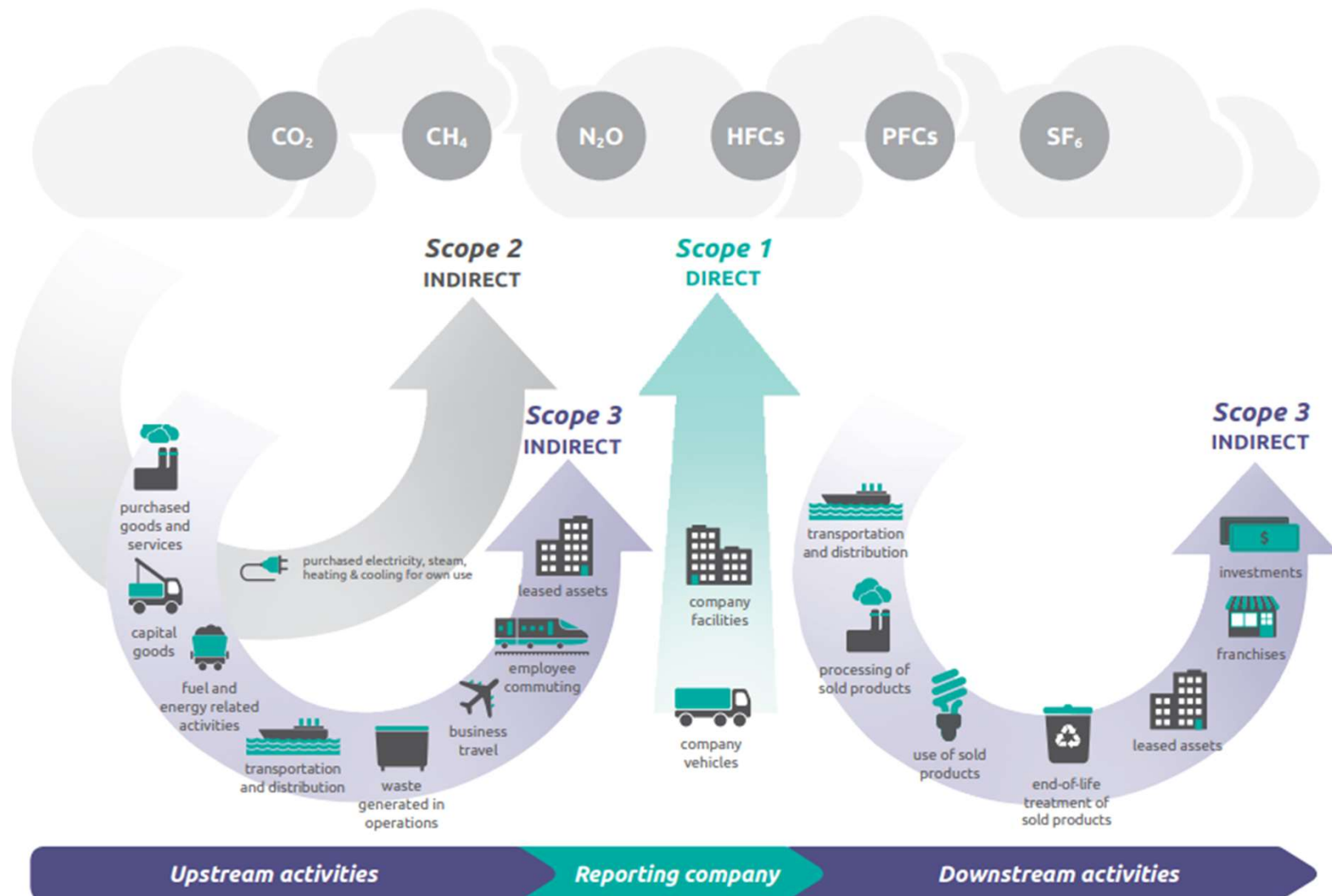


Final Manufacturer Attributes Affecting Extended Supply Chain Transparency

Chulhwan Kwon

The Issue

Different Scopes of emission

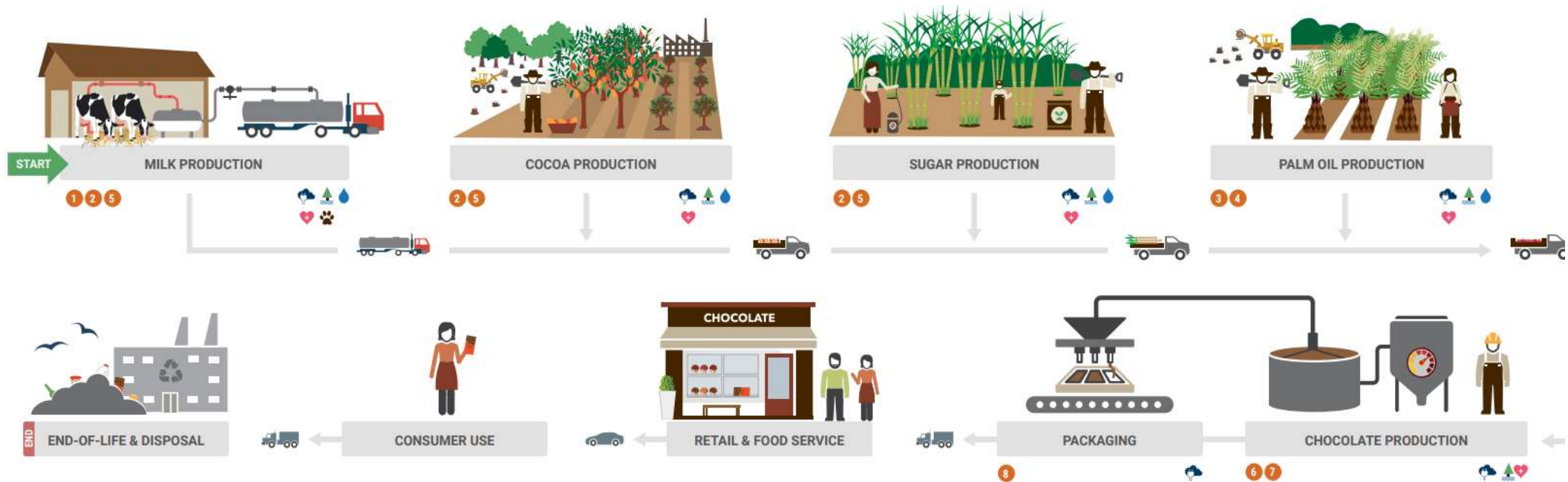


Increasing interest for Scope 3

- SB 253
 - California Climate Corporate Data Accountability Act
 - Requires public and some private companies to disclose Scope 1, Scope 2, and Scope 3 emissions starting 2026
- European Sustainability Reporting Standards
 - Requires public-interest entities operating in the European Union (EU), and non-EU companies with significant EU operations disclose Scope 1, 2, and 3 emissions

The Issue

Lack of extended supply chain transparency



Lack of extended supply chain transparency

- Limited governability and visibility
- Risk of non-compliance
- Lack of Awareness and Motivation
- Capability constraints

Fear of growers

- Regulatory penalties
- Market impact
- Public perception

The Question

What are a buying firm's attributes that make it more likely that their upstream growers will measure and disclose Scope 1 and 2 GHG emissions?

Settings

- Objective
 - Explore factors influencing greenhouse gas (GHG) emissions disclosure by far-upstream agricultural suppliers within food manufacturing supply chains.
- Framework
 - Utilizes the Awareness-Motivation-Capability (AMC) model to assess the impact of final manufacturer attributes on upstream supplier transparency.
- Data Source
 - Food manufacturers and their upstream agricultural grower's transparency data collected via The Sustainability Insight System (THESIS) by The Sustainability Consortium (TSC)

Transparency = Traceability?

- “The **ability to track** a product batch and its history through the whole, or part, of a production chain from harvest through transport, storage, processing, distribution and sales (hereafter called chain traceability) or internally in one of the steps in the chain for example the production step (hereafter called internal traceability)” (Moe, 1998)
- “an **ability to access specific information** about a food product that has been captured and integrated with the product’s recorded identification throughout the supply chain” (Islam & Cullen, 2021)

Transparency = Traceability + Disclosure

AMC model

- Awareness
 - firm's alertness with regard to the market
- Motivation
 - incentives that drive a firm to undertake actions
- Capability
 - cognitive and resource-based factors that influence the firm's ability to take action

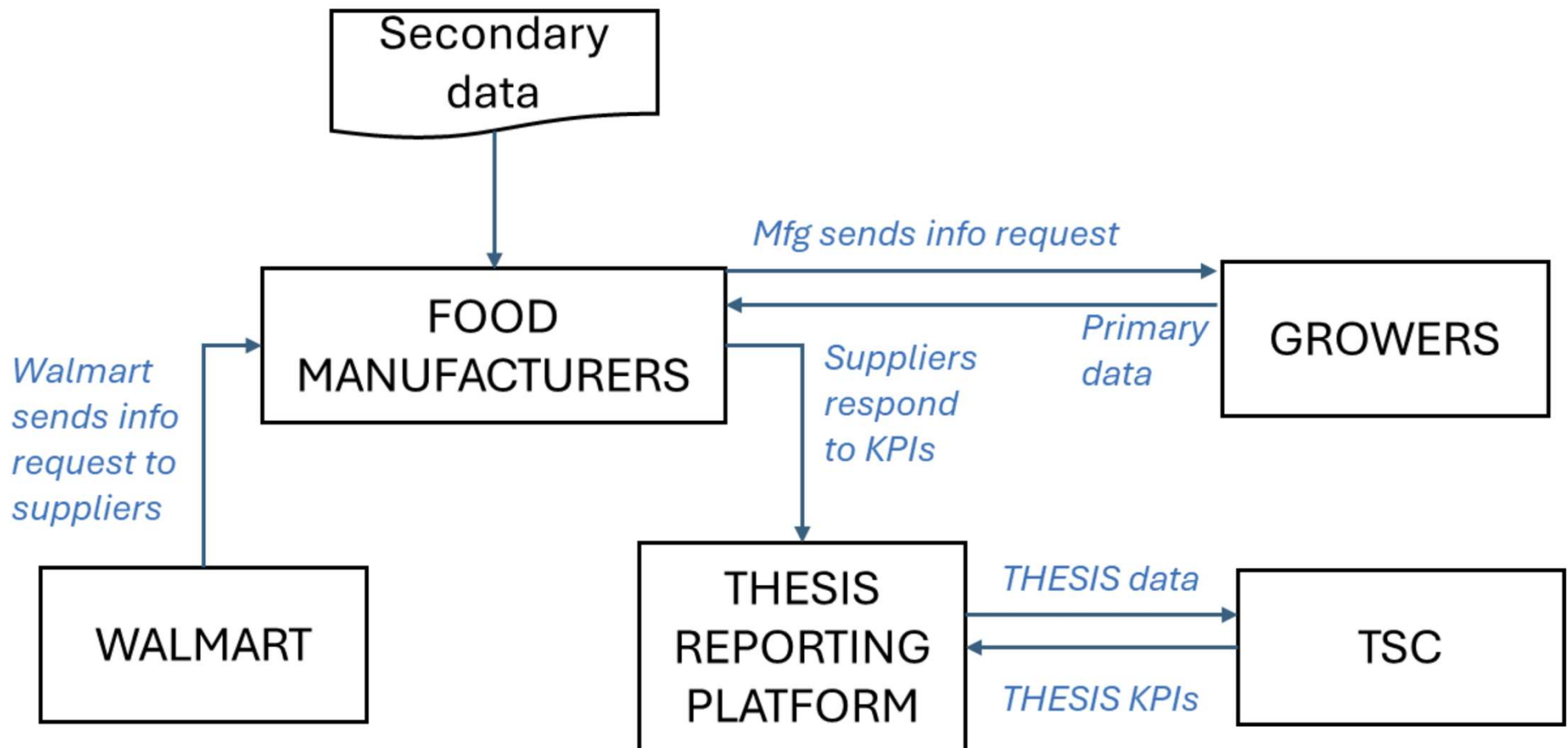
AMC model in the context of sustainability transparency

- Awareness
 - suppliers knowing that downstream buyers value and require detailed GHG emissions information
- Motivation
 - internal and external drivers that compel suppliers to engage in transparency
- Capability
 - the resources, tools, and skills necessary for effective data handling and disclosure

Extended supply chain transparency

- The aggregate level of GHG emissions information that a final manufacturer's growers make available to the them and their downstream retailer.
- *Proposition: A food manufacturer will have greater extended supply chain transparency about GHG emissions when they help their growers be (1) aware that they (the buyer) want GHG emissions information, (2) motivated to be transparent, and (3) capable of measuring and disclosing GHG emissions.*

Data flow in THESIS



Examples

9. GREENHOUSE GAS EMISSIONS INTENSITY - ANIMAL FARM OPERATIONS

Question

What was the greenhouse gas emissions intensity associated with the animal farm operations and feed producers in your supply chain?

Response Options

- A. We are unable to determine at this time.
- B. Our greenhouse gas emissions intensity was:
 - B1. _____ kg CO2e per metric tonne of milk.
 - B2. _____% of our milk supply, by mass, is represented by the number reported above.

Examples

- Calculate B1 as the average of the greenhouse gas emission intensity estimates for the animal farm operations that produced your milk supply, weighted by the mass of milk supplied by each farm.
- *Calculate B2 as the mass of milk supply, for which you were able to obtain primary greenhouse gas intensity data, divided by the total mass of your milk supply then multiply by 100. If you have reported a regional estimate for B1, then report 0% for B2.*

Awareness

- Company size
 - Annual revenue of the company
- Company type
 - Whether the company stock is publicly traded or not

Motivation

- Sustainability team
 - Whether the company has a sustainability team, and the number of employees within the sustainability team
- Sustainability interest
 - Based on the reason companies reported for participating in THESIS, indicate those participated for the use of the data for external or internal sustainability activities
- Disclosure
 - Whether the company has a publicly available sustainability report

Capabilities

- Past experience
 - The number of years the company participated in THESIS
- Other experience
 - The number of different sustainability reporting tools that the company uses other than THESIS
- Information source
 - The source of information used to report to THESIS

Controls

- Number of assessments
- Total sustainability transparency score
- GHG planning maturity
- Contract manufacturing
- Sourcing homogeneity
- Sustainability priorities
- Number of competitors
- Assessment groups

Descriptive

Variables	Categories	N	Percent
Extended Supply Chain Transparency		0	565
		1	232
	Total	797	100.00%
Company Size	Did not Specify	147	18.40%
	1-10 million USD	39	4.90%
	10-100 million USD	163	20.50%
	100 million-1 billion USD	247	31.00%
	Greater than 1 billion USD	201	25.20%
	Total	797	100.00%
Company Type	Private	607	76.20%
	Public	190	23.80%
	Total	797	100.00%
	Did not specify interest	516	64.70%
Sustainability Interest	Specified interest	281	35.30%
	Total	797	100.00%
	No Disclosure	567	71.10%
Disclosure	Public Disclosure	230	28.90%
	Total	797	100.00%
Sustainability Team Size	None	187	23.50%
	1 to 2	305	38.30%
	3 to 5	172	21.60%
	6 to 10	57	7.20%
	11 to 20	26	3.30%
	More than 20	50	6.30%
	Total	797	100.00%
	Information Source	0	254
Information Source		1	11
		2	327
		3	205
	Total	797	100.00%

Descriptive

Variables	Categories N	Percent	
KPI Category	Animal Base Foods	24	3.00%
	Apples and Pears	24	3.00%
	Beans Lentils and Peas	8	1.00%
	Beef	24	3.00%
	Beef Cow Calf	5	0.60%
	Berries and Grapes	92	11.50%
	Chicken	18	2.30%
	Citrus	48	6.00%
	Coffee	10	1.30%
	Complex Foods and Beverages	80	10.00%
	Cookies and Baked Goods	22	2.80%
	Cucumbers Melons and Squash	28	3.50%
	Dairy	36	4.50%
	Eggs	5	0.60%
	Farmed Fish	17	2.10%
	Grain-based Foods	29	3.60%

Variables	Categories N	Percent	
KPI Category	Grains	15	1.90%
	Juice	13	1.60%
	Lettuce and Leaf Vegetable s	30	3.80%
	Non Dairy Products	7	0.90%
	Plant based Foods	44	5.50%
	Pork	14	1.80%
	Root Vegetable s	20	2.50%
	Soda and Sports Drinks	5	0.60%
	Soup and Convenience Meals	41	5.10%
	Stone Fruit	47	5.90%
	Tomatoes Peppers and Eggplant	49	6.10%
	Tropical and Specialty Fruit	34	4.30%
	Turkey	8	1.00%
	Total	797	100.00%

Descriptive

Variables	Categories	N	Percent	
Contract Manufacturing		0	455	57.10%
		1	342	42.90%
	Total		797	100.00%
Sourcing Distance		0	214	26.90%
		1	583	73.10%
	Total		797	100.00%
Sustainability Priorities		0	695	87.20%
		1	102	12.80%
	Total		797	100.00%

Variable	Minimum	Maximum	Mean	SD
Past Experience	0	5	4.15	1.285
Other Experience	0	4	0.4	0.6
Number of Assessments	1	32	7.46	8.085
Corporate Sustainability	0	100	48.77	42.987
GHG Goal	0	2	0.22	0.585

Results

Variable	B	S.E.	Wald X2	df	p	Exp(B)
Company Size			7.397	4	0.116	
Company Size (1)	-1.429	0.738	3.748	1	0.053	0.24
Company Size (2)	-0.833	0.449	3.451	1	0.063	0.435
Company Size (3)	-0.217	0.438	0.246	1	0.620	0.805
Company Size (4)	-0.728	0.641	1.291	1	0.256	0.483
Company Type (1)	-1.054	0.428	6.075	1	0.014	0.349
Sustainability Interest (1)	0.376	0.334	1.267	1	0.26	1.457
Past Experience	0.406	0.138	8.688	1	0.003	1.501
Other Experience	0.163	0.226	0.518	1	0.472	1.176
Disclosure (1)	-0.232	0.379	0.373	1	0.541	0.793
Sustainability Team Size			15.946	5	0.007	
Sustainability Team Size (1)	0.843	0.423	3.966	1	0.046	2.323
Sustainability Team Size (2)	1.648	0.477	11.917	1	0.001	5.195
Sustainability Team Size (3)	0.148	0.74	0.04	1	0.841	1.16
Sustainability Team Size (4)	0.853	0.778	1.204	1	0.272	2.348
Sustainability Team Size (5)	1.003	0.653	2.361	1	0.124	2.726
Information Source			6.851	3	0.077	
Information Source (1)	-0.43	0.992	0.188	1	0.664	0.65
Information Source (2)	-0.926	0.359	6.645	1	0.01	0.396
Information Source (3)	-0.471	0.403	1.366	1	0.243	0.624
Number of Assessments	0.075	0.023	11.017	1	0.001	1.078

Results

Variable	B	S.E.	Wald X2	df	p	Exp(B)
KPI Category			50.762	28	0.005	
KPI Category (1)	1.078	1.005	1.152	1	0.283	2.94
KPI Category (2)	-1.526	1.78	0.735	1	0.391	0.217
KPI Category (3)	-1.446	1.309	1.219	1	0.270	0.236
KPI Category (4)	-19.11	16914.01	0	1	0.999	0
KPI Category (5)	1.405	0.828	2.879	1	0.090	4.077
KPI Category (6)	-20.9	8143.088	0	1	0.998	0
KPI Category (7)	-0.362	0.891	0.165	1	0.684	0.696
KPI Category (8)	0.12	1.235	0.009	1	0.922	1.128
KPI Category (9)	-22.631	3518.302	0	1	0.995	0
KPI Category (10)	-1.72	1.073	2.57	1	0.109	0.179
KPI Category (11)	0.709	0.995	0.508	1	0.476	2.032
KPI Category (12)	1.393	0.861	2.618	1	0.106	4.029
KPI Category (13)	-19.379	16223.29	0	1	0.999	0
KPI Category (14)	0.363	1.018	0.127	1	0.722	1.437
KPI Category (15)	-3.166	1.394	5.161	1	0.023	0.042
KPI Category (16)	-0.883	1.114	0.628	1	0.428	0.414
KPI Category (17)	-23.536	9475.912	0	1	0.998	0
KPI Category (18)	0.004	0.969	0	1	0.996	1.004
KPI Category (19)	-23.525	13236.83	0	1	0.999	0
KPI Category (20)	-1.12	0.926	1.464	1	0.226	0.326
KPI Category (21)	-1.652	1.358	1.48	1	0.224	0.192
KPI Category (22)	-0.08	0.97	0.007	1	0.934	0.923
KPI Category (23)	-23.425	16044.95	0	1	0.999	0
KPI Category (24)	-23.145	5207.028	0	1	0.996	0
KPI Category (25)	0.099	0.884	0.012	1	0.911	1.104
KPI Category (26)	1.004	0.902	1.239	1	0.266	2.731
KPI Category (27)	0.609	0.964	0.4	1	0.527	1.839
KPI Category (28)	-0.299	1.311	0.052	1	0.820	0.742
Corporate Sustainability	0.034	0.004	74.029	1	0.000	1.034
GHG Goal	1.79	0.35	26.194	1	0.000	5.99
Contract Manufacturing (1)	0.731	0.306	5.715	1	0.017	2.078
Sourcing Distance (1)	-0.89	0.345	6.657	1	0.010	0.411
Sustainability Priorities (1)	-0.676	0.428	2.495	1	0.114	0.509
Competitors	0.056	0.047	1.387	1	0.239	1.057
Constant	-5.061	0.957	27.982	1	0.000	0.006

Results after modification

Variable	B	S.E.	Wald X2	df	p	Exp(B)
Company Size			4.829	3	0.185	
Company Size (1)	1.878	1.156	2.639	1	0.104	6.537
Company Size (2)	1.601	1.219	1.723	1	0.189	4.957
Company Size (3)	3.068	1.5	4.182	1	0.041	21.507
Company Type (1)	0.74	0.711	1.083	1	0.298	2.096
Sustainability Interest (1)	0.594	0.483	1.514	1	0.219	1.812
Past Experience	0.444	0.209	4.527	1	0.033	1.559
Other Experience	0.301	0.336	0.804	1	0.370	1.351
Disclosure (1)	-1.593	0.663	5.77	1	0.016	0.203
Sustainability Team Size			30.206	5	0.000	
Sustainability Team Size (1)	0.387	0.712	0.296	1	0.586	1.473
Sustainability Team Size (2)	3.378	0.9	14.097	1	0.000	29.303
Sustainability Team Size (3)	1.488	1.342	1.23	1	0.267	4.427
Sustainability Team Size (4)	1.051	2.073	0.257	1	0.612	2.86
Sustainability Team Size (5)	4.816	1.279	14.188	1	0.000	123.485
Information Source			2.371	3	0.499	
Information Source (1)	-19.022	11963.09	0	1	0.999	0
Information Source (2)	0.44	0.739	0.355	1	0.551	1.553
Information Source (3)	1.041	0.735	2.006	1	0.157	2.831

Results after modification

Variable	B	S.E.	Wald X2	df	p	Exp(B)
Number of Assessments	0.079	0.048	2.71	1	0.100	1.083
KPI Category			30.531	28	0.338	
KPI Category (1)	1.773	1.921	0.851	1	0.356	5.886
KPI Category (2)	-0.513	3.377	0.023	1	0.879	0.599
KPI Category (3)	-1.858	2.049	0.822	1	0.365	0.156
KPI Category (4)	-18.453	20940.788	0	1	0.999	0
KPI Category (5)	2.944	1.798	2.68	1	0.102	18.984
KPI Category (6)	-22.152	7960.39	0	1	0.998	0
KPI Category (7)	0.387	1.84	0.044	1	0.833	1.473
KPI Category (8)	-5.583	13.171	0.18	1	0.672	0.004
KPI Category (9)	-30.906	3549.712	0	1	0.993	0
KPI Category (10)	3.138	1.972	2.533	1	0.111	23.068
KPI Category (11)	4.959	2.018	6.04	1	0.014	142.451
KPI Category (12)	1.252	1.786	0.492	1	0.483	3.497
KPI Category (13)	-17.619	21404.471	0	1	0.999	0
KPI Category (14)	7.953	2.684	8.78	1	0.003	2844.463
KPI Category (15)	-0.654	2.361	0.077	1	0.782	0.52
KPI Category (16)	1.777	2.051	0.751	1	0.386	5.91
KPI Category (17)	-33.783	9090.898	0	1	0.997	0
KPI Category (18)	1.598	1.894	0.713	1	0.399	4.945
KPI Category (19)	-34.864	21855.043	0	1	0.999	0
KPI Category (20)	0.418	1.93	0.047	1	0.829	1.518
KPI Category (21)	-2.647	2.323	1.299	1	0.254	0.071
KPI Category (22)	1.752	1.919	0.834	1	0.361	5.767
KPI Category (23)	-24.758	18652.808	0	1	0.999	0
KPI Category (24)	-32.997	4440.172	0	1	0.994	0
KPI Category (25)	1.091	1.868	0.341	1	0.559	2.977
KPI Category (26)	2.708	1.936	1.956	1	0.162	15.003
KPI Category (27)	0.813	1.965	0.171	1	0.679	2.254
KPI Category (28)	-1.381	2.142	0.416	1	0.519	0.251
Corporate Sustainability	0.043	0.007	34.125	1	0.000	1.044
GHG Goal	1.907	0.647	8.694	1	0.003	6.73
Contract Manufacturing (1)	0.527	0.522	1.018	1	0.313	1.694
Number of Sourcing Areas			20.285	6	0.002	
Number of Sourcing Areas (1)	-3.429	1.03	11.072	1	0.001	0.032
Number of Sourcing Areas (2)	-2.171	1.12	3.759	1	0.053	0.114
Number of Sourcing Areas (3)	-19.336	7960.534	0	1	0.998	0
Number of Sourcing Areas (4)	-2.442	2.008	1.48	1	0.224	0.087
Number of Sourcing Areas (5)	6.03	2.311	6.808	1	0.009	415.849
Number of Sourcing Areas (6)	6.497	2.081	9.746	1	0.002	663.303
Sustainability Priorities (1)	-1.221	0.685	3.173	1	0.075	0.295
Competitors	0.044	0.063	0.486	1	0.486	1.045
Constant	-11.642	2.437	22.825	1	0.000	0

Q&A