

Measuring Corporate Culture Using Machine Learning



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Connor McDowell

Evolution of Corporate Culture

Top and bottom-ranked S&P500 firms by corporate cultural values

A. Top- and bottom-ranked S&P 500 firms, 2001–2006

Innovation	Integrity
Procter & Gamble Co	Fannie Mae
Nvidia Corp	Franklin Resources Inc
Gap Inc	Kate Spade & Co
Lauder (Estee) Cos Inc	Encompass Health Corp
PTC Inc	Synovus Financial Corp
Penney (JC) Co	Northwest Airlines Corp
Harman International Inds	EMCOR Group Inc
Home Depot Inc	Exelon Corp
Kate Spade & Co	Service Corp International
BroadVision Inc	Compuware Corp

B. Top- and bottom-ranked S&P 500 firms, 2007–2012

Innovation	Integrity
Nvidia Corp	Procter & Gamble Co
Adobe Inc	Wynn Resorts Ltd
Discovery Inc	Beam Inc
Lauder (Estee) Cos Inc	Ambac Financial Group Inc
Netflix Inc	Intercontinental Exchange
Salesforce.com Inc	Lockheed Martin Corp
VF Corp	Exelon Corp
Fossil Group Inc	American Electric Power Co
Kate Spade & Co	Kate Spade & Co

C. Top- and bottom-ranked S&P 500 firms, 2013–2018

Innovation	Integrity
Netflix Inc	Blackrock Inc
Fossil Group Inc	Wynn Resorts Ltd
Nike Inc	Ambac Financial Group Inc
Lauder (Estee) Cos Inc	Big Lots Inc
Procter & Gamble Co	Intercontinental Exchange
Adobe Inc	Gap Inc
Salesforce.com Inc	Genworth Financial Inc
Acuity Brands Inc	U.S. Bancorp
Twitter Inc	News Corp
Facebook Inc	United States Steel Corp

Innovation	Integrity
Luby's Inc	VF Corp
Genuine Parts Co	Luby's Inc
Univision Communications	M & T Bank Corp
Patterson Cos Inc	Amazon.Com Inc
Archer-Daniels-Midland Co	TECO Energy Inc
Tyson Foods Inc	Bristol-Myers Squibb Co
Automatic Data Processing	Bausch & Lomb Hldgs
Texas Instruments Inc	Regions Financial Corp
Tribune Media Co	Citigroup Inc
CenturyLink Inc	Equity Residential

Innovation	Integrity
Genuine Parts Co	Bausch & Lomb Hldgs
CVS Health Corp	Public Storage
Univision Communications	Sigma-Aldrich Corp
Archer-Daniels-Midland Co	Wyndham Destinations Inc
American Greetings	VF Corp
Texas Instruments Inc	Equity Residential
Ryerson Holding Corp	Winn-Dixie Stores Inc
DXC Technology Co	Host Hotels & Resorts Inc
Patterson Cos Inc	Spire Inc
Cintas Corp	Luby's Inc

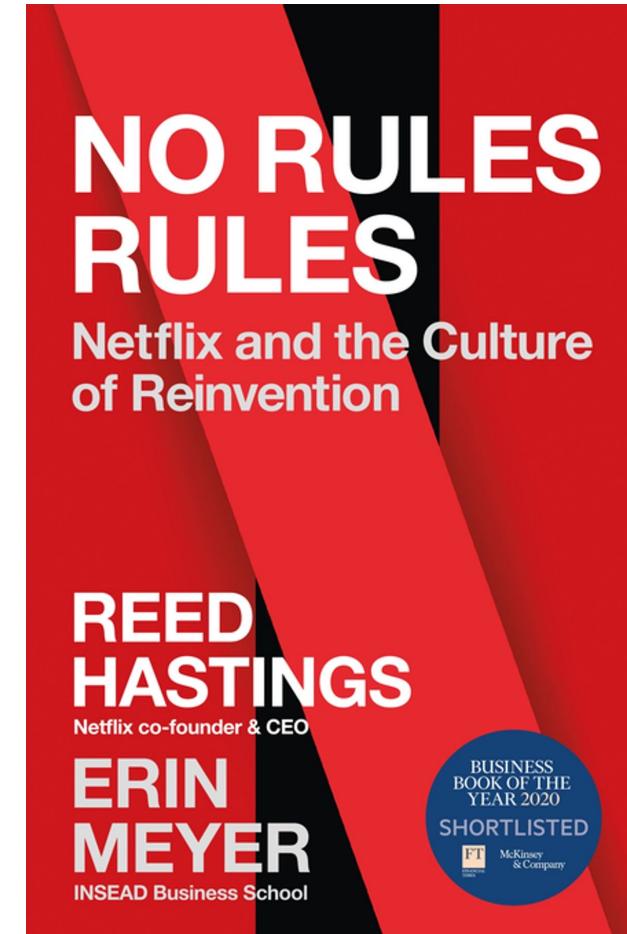
Innovation	Integrity
Archer-Daniels-Midland Co	National Fuel Gas Co
Genuine Parts Co	Idexx Labs Inc
FleetCor Technologies Inc	Cooper Cos Inc (The)
Univision Communications	SBA Communications Corp
LKQ Corp	IDACORP Inc
Philip Morris International	ONEOK Inc
Cintas Corp	Ryder System Inc
Costco Wholesale Corp	CenterPoint Energy Inc
Emerson Electric Co	Williams Cos Inc
Texas Instruments Inc	Public Storage

Corporate Culture?

What is the purpose of having a corporate culture? What does it mean?

Definitions and prior literature inform nebulous nature

- A system of shared values and norms defining what is important, appropriate attitudes, and behaviors for organizational members (O'Reilly and Chatman, 1996)
- 'Path dependent and can be shaped by major corporate events (Weber et al., 1996; Guiso et al., 2015; Graham et al., 2018; Grennan, 2018)
- Important because employees will inevitably face choices that cannot be properly regulated ex-ante (O'Reilly, 1989; Kreps, 1990)
- Extant literature has limited large sample evidence, possibly due to nebulous nature creating measurement issues



Research Intent

What is the purpose of this article? What is a strong corporate culture?

Paper claims to address issues facing textual analysis

- Proposition of semi-supervised machine learning algorithm to measure corporate culture
- A methodological contribution to the accounting/finance literatures by introducing word embedding models to score corporate cultures
 - Assess management's alignment with corporate values, and ability to lead by example
 - Measure the true representation of corporate culture, applying less weighting to frequently occurring words
 - Explore implications of having a strong culture on business outcomes
- Innovate within the field of textual analysis through a better quantify semantics via vectorization, in addition to syntactic expressions
 - Previous methods have firm policy proxies explaining relationships with culture, or relying on surveys



Data & Methodology

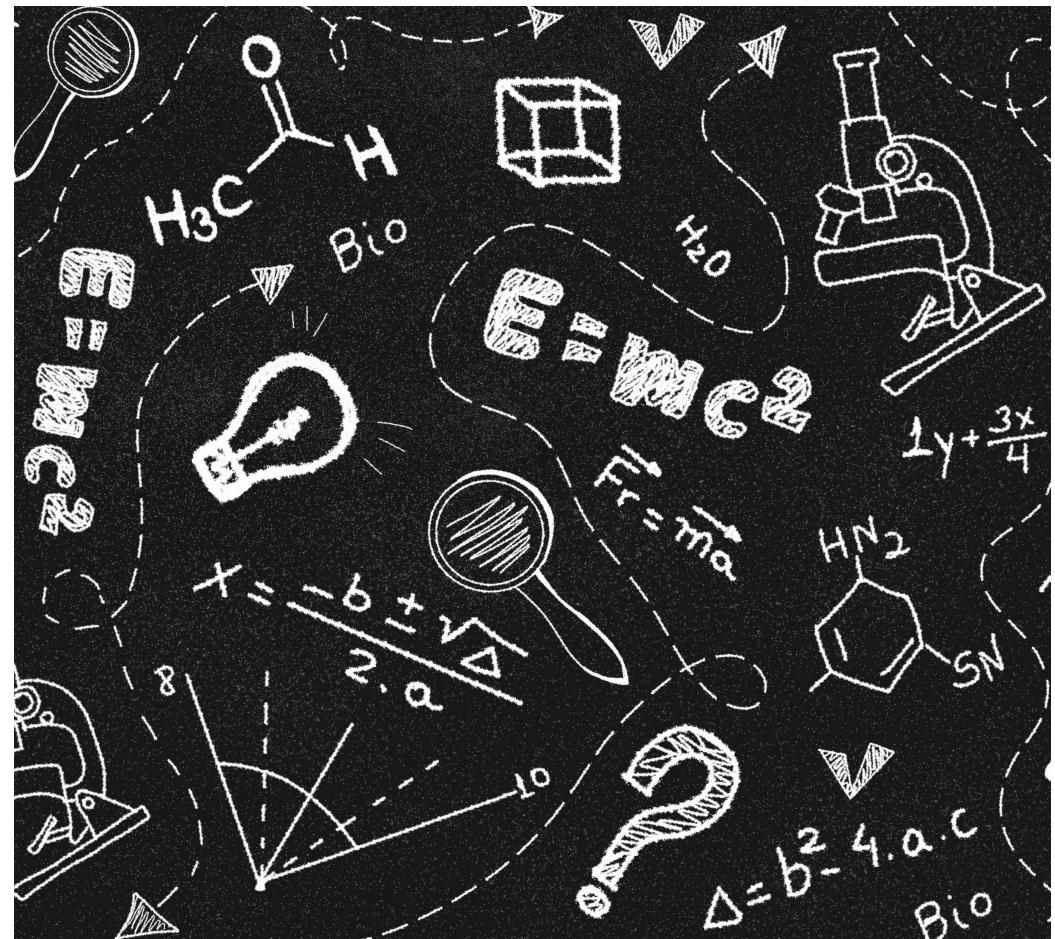
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Overview of Methodology

This section provides a high-level overview of the methodology

The authors follow the subsequent implementation:

- 1) Data, Preprocessing and Parsing, and Learning Phrases
 - 1) Earnings call to score corporate culture
 - 2) Data, preprocessing and parsing, and learning phrases
- 2) Word Embedding, word2vec, and Model Training
- 3) Measuring corporate culture using word2vec
 - 1) Seed words
 - 2) Generating the culture dictionary
 - 3) Scoring corporate culture
- 4) Validating measures of corporate culture
 - 1) Validation Tests
 - 2) Corporate Culture and its markers
 - 3) Other ways of measuring corporate culture
 - 4) Addressing self-promotion in calls
 - 5) Words with multiple senses



Data, Processing and Parsing, and Learning Phrases

Why do organizations conduct earnings calls? What is their purpose?

Executives heavily influence culture

- The most influential factor in building a firm's current culture is the current CEO, consistent with results surveying top executives
- Prior studies have used CEO attributes and behaviours to proxy corporate culture
- Subsequently, earnings call transcript deemed a suitable external sources to measure corporate culture as prominently feature chief executives and other top executives
- Call emphasis business operations, and performance, without promoting or 'window dressing' corporate culture
- Q&A section most appropriate as less likely to be scripted/vetted by corporate lawyers and investor relations
- Methodology capable of learning copious amounts of culture value-related words/weighting scheme



Data, Processing and Parsing, and Learning Phrases

Why match the extracted metadata to the compustat database ?

Authors use a comprehensive dataset

- Transcripts extracted from Thompson Reuters' StreetEvents (SE) database for January 1st, 2001, to May 25th, 2018
- Each file contains the body of a call transcript and subsequent metadata; ticker symbol, company name, title of the event, and call date
- After matching with Compustat database:
 - 209,480 QA sections mapped to 64,511 firm-year observations
- Use the Stanford CoreNLP package to preprocess and parse text, segmenting documents into sentences and word, lemmatizing words into base forms, to extract general/corpus-specific phrases
 - Phrases (collocations) crucial for gathering information
 - Identify fixed, multi-word/compound expressions
 - Identify two/three-word phrases specific to corpus

	# firm-year obs.	# firm-year obs. removed	# transcripts	# transcripts removed
Match company names in call transcripts to GVKEY				
All conference call transcripts			391,091	
Earnings call transcripts			270,879	120,212
Transcripts matched with GVKEY	66,371		221,209	49,670
Including				
Perfect match with CRSP company name	21,627			
Perfect match with Compustat company name	7,355			
Perfect match with Compustat-CRSP merged	1,238			
Ticker matching if not subject to backfilling	559			
Manual matching if no perfect match	35,075			
Non-duplicated company name in brief files	517			
Transcripts without the QA section	65,247	1,124	214,295	6,914
Transcripts with fewer than 200 words in the QA section	64,511	736	209,480	4,815
Sample formation for Table 3				
After applying 3-year rolling average	84,144			
After imposing fiscal year \leq 2018	76,232		7,912	
After matching with financial data	62,664		13,568	
Final sample	62,664			

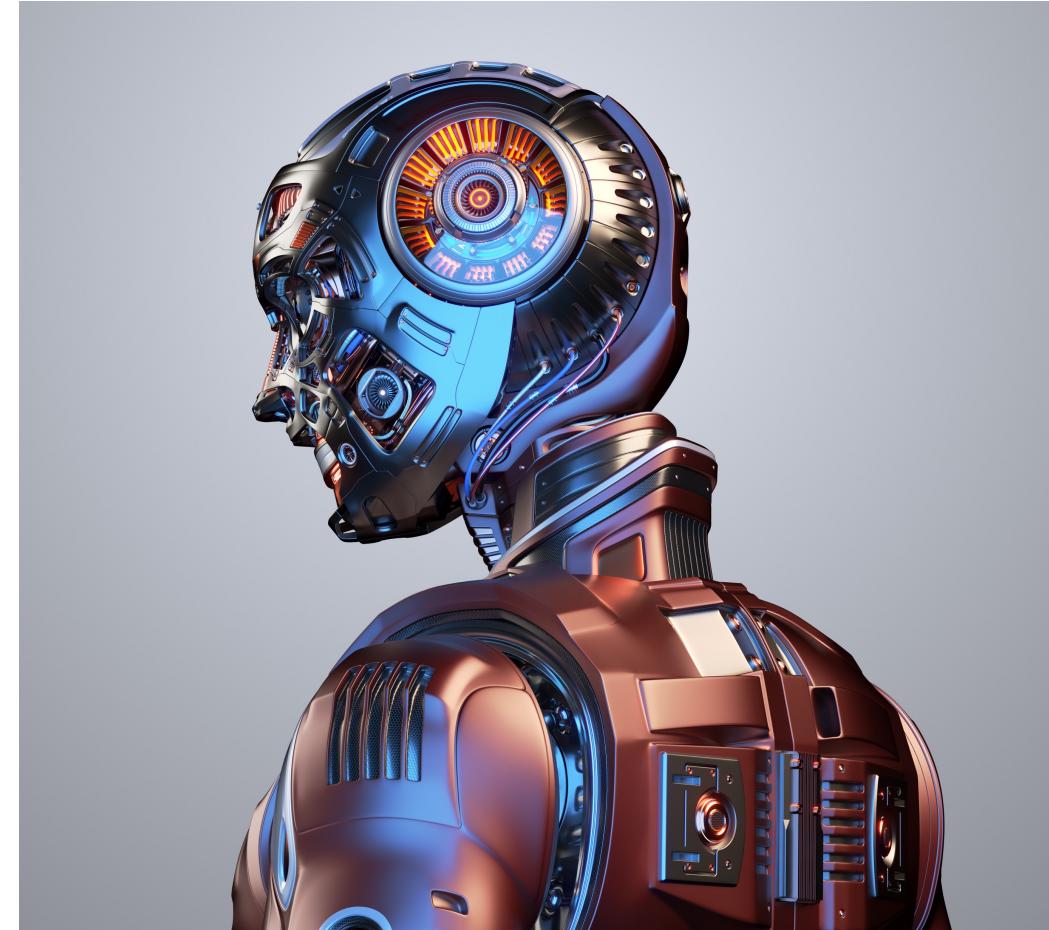
Why is it important to identify transcripts without Q&A sections?

Word Embedding, word2vec, and Model Training

What is machine learning?

Machine learning can be used for textual analysis

- Increasing reliance on automated textual analysis to extract information from corporate disclosures for research in accounting and finance
- A common method to measure sentiment is quantifying the reoccurrence of words with shared meaning, a laborious process from manual inspection and categorization of words
- Corporate culture; is often discussed in subtle, nuance fashions; can be an elusive, multi-dimensional construct; unrealistic to presume that experts could create and maintain dictionaries capable of adapting to the constant paradigm shifts in the business world
- A machine learning algorithm addresses the challenges



Introduction to Neural Networks

Neural networks inform Natural Language Processing Implementation

Introduction to Algorithms: Neural Networks

- A feedforward artificial neural network (ANN) is a series of layered perceptrons
- A linear threshold unit (LTU) feeds a weighted sum of input values into a step/activation function to determine the output. A perception is a single layer of interconnected LTUs
 - Activation functions: sigmoid, hypertangent, and linear
- Perceptions utilize a training algorithm to assess the strength of connections between perceptions
 - **Back propagation**, steepest descent, conjugate gradient, modified newton, and genetic algorithm etc.
- A perception makes predictions on an instance one at a time, re-enforcing the connection weights from incorrect LTU prediction to improve performance

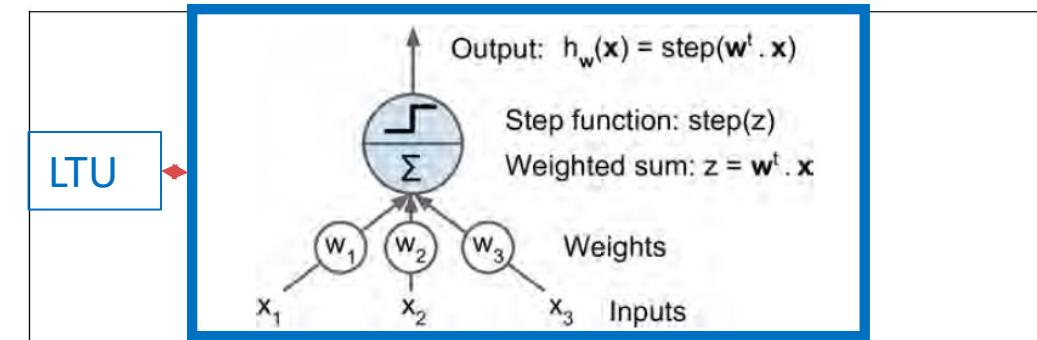


Figure 10-4. Linear threshold unit

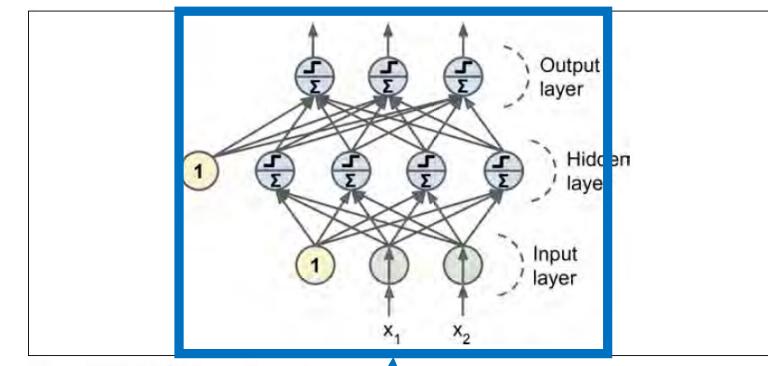


Figure 10-7. Multi-Layer Perceptron

Multi-layer Perception

Measuring Corporate Culture Using word2vec

What are some corporate values?

NLP innovate word embedding methods

- Word embedding represents semantics as a numerical vector, enabling vector arithmetic to determine relationships, assessing neighborhoods for similar meanings. This is complex given the number of combinations
- Natural language processing (NLP), word2vec, employs a 'neural network' to efficiently learn dense and low-dimensional vectors that can represent the meaning of words
- The five most-often mentioned values by the S&P 500 firms on their corporate websites, adding seed words in the transcripts, and unambiguously-related to the culture words
 - 1) Innovation (80%)
 - 2) Integrity (70%)
 - 3) Quality (60%)
 - 4) Respect (70%)
 - 5) Teamwork (50%)



Measuring Corporate Culture Using word2vec

How do you measure similarities between words?

Scoring corporate culture is feasible

- Scores the corporate culture by measuring the each of the five cultural values at the firm value.
- A weighted count, considering both term frequency, and inverse document frequency, accounts for both the importance of a word in a document and the significance of the word in the corpus.
- Provide summary statistics, measuring corporate culture using three year moving averages, with a final sample consisting of 7,501 firms and 62,664 firm-year observations
- Innovation and integrity are most and least frequently mentioned respectively



Measuring Corporate Culture Using word2vec

Do these associations surprise you?

A. Thirty most representative words for each cultural value in the culture dictionary

Innovation	Integrity	Quality	Respect	Teamwork
Creativity	Accountability	Dedicated	Talented	Collaborate
Innovative	Ethic	Quality	Talent	Cooperation
Innovate	Integrity	Dedication	Empower	Collaboration
Innovation	Responsibility	Customer_service	Team_member	Collaborative
Creative	Transparency	Customer	Employee	Cooperative
Excellence	Accountable	Dedicate	Team	Partnership
Passion	Governance	Service_level	Leadership	Cooperate
World-class	Ethical	Mission	Leadership_team	Collaboratively
Technology	Transparent	Service_delivery	Culture	Partner
Operational_excellence	Trust	Customer_satisfaction	Teammate	Co-operation

B. Thirty most frequently occurring words for each cultural value in the culture dictionary

Innovation			Integrity			Quality			Respect			Teamwork		
Word	%	Cum.%	Word	%	Cum.%	Word	%	Cum.%	Word	%	Cum.%	Word	%	Cum.%
Brand	4.24	4.24	Control	5.81	5.81	Customer	9.22	9.22	People	5.91	5.91	Partner	6.01	9.22
Technology	3.08	7.32	Management	4.93	10.74	Product	8.09	17.31	Team	5.10	11.00	Relationship	5.36	17.31
Focus	3.02	10.34	Careful	3.46	14.19	Client	5.99	23.30	Company	5.00	16.00	Discussion	5.22	23.30
Great	2.73	13.08	Honestly	2.71	16.90	Service	4.72	28.02	Hire	3.78	19.78	Together	4.61	28.02
Platform	2.53	15.61	Regulator	2.68	19.58	Build	4.09	32.11	Folk	3.61	23.39	Integrate	4.07	32.11
Ability	2.41	18.02	Honest	2.43	22.01	Deliver	3.42	35.54	Organization	3.39	26.78	Involve	3.77	35.54
Best	2.37	20.39	Safety	2.09	24.10	Network	3.30	38.84	Resource	3.11	29.89	Conversation	3.73	38.84
Design	2.19	22.58	Assure	2.01	26.11	Support	3.12	41.96	Employee	2.96	32.86	Integration	3.24	41.96
Create	2.18	24.76	Compliance	1.88	27.98	Quality	2.40	44.36	Management_team	1.91	34.77	Partnership	3.17	44.36
Solution	2.16	26.92	Trust	1.87	29.86	Sales_force	2.31	46.68	Train	1.88	36.65	Engage	2.65	46.68
Develop	2.12	29.04	Disciplined	1.82	31.68	Infrastructure	2.27	48.94	Training	1.81	38.46	Align	2.07	48.94
Success	2.00	31.04	Responsible	1.71	33.39	Supplier	2.21	51.16	Senior	1.80	40.26	Explore	1.79	51.16

Measuring Corporate Culture Using word2vec

What do you notice about the auto-correlations and correlation matrix?

B. Autocorrelations of corporate cultural values

Variable in year t	Obs.	Year $t - 1$	Year $t - 2$	Year $t - 3$	Year $t - 4$	Year $t - 5$
Innovation	1,971	0.790 [0.828] (0.151)	0.512 [0.559] (0.301)	0.190 [0.203] (0.441)	0.090 [0.071] (0.475)	0.045 [0.031] (0.500)
Integrity	1,971	0.695 [0.728] (0.179)	0.361 [0.378] (0.292)	-0.037 [-0.071] (0.397)	-0.085 [-0.141] (0.405)	-0.103 [-0.160] (0.434)
Quality	1,971	0.738 [0.776] (0.442)	0.417 [0.442] (0.029)	0.052 [0.029] (-0.082)	-0.023 [-0.082] (-0.116)	-0.051 (-0.116)

C. The correlation matrix

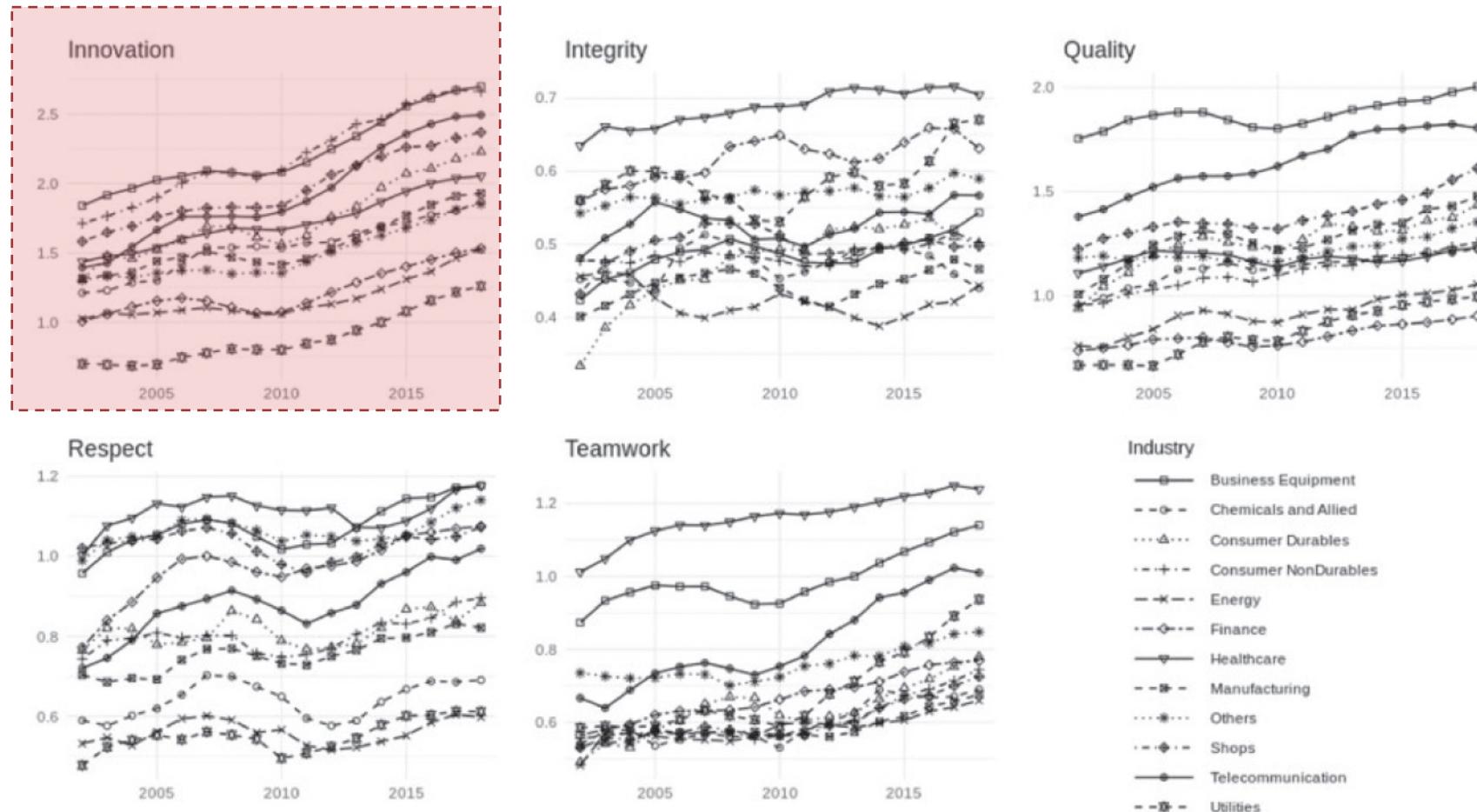
	Innovation	Integrity	Quality	Respect	Teamwork	Firm size	Leverage	ROA	Sales growth	Top-5 institutions
Innovation	1.000									
Integrity	0.109***	1.000								
Quality	0.490***	0.023***	1.000							
Respect	0.321***	0.269***	0.317***	1.000						
Teamwork	0.371***	0.276***	0.271***	0.258***	1.000					
Firm size	-0.186***	-0.010**	-0.261***	-0.255***	-0.309***	1.000				
Leverage	-0.282***	0.024	-0.276***	-0.170***	-0.199***	0.360***	1.000			
ROA	-0.105***	-0.130***	-0.069***	-0.093***	-0.352***	0.403***	-0.035***	1.000		
Sales growth	-0.008**	-0.047***	0.017***	0.033***	-0.025***	0.057***	-0.076***	0.222***	1.000	
Top-5 institutions	0.059***	-0.096***	0.018***	0.033***	-0.081***	0.027***	-0.084***	0.145***	0.050***	1.000

Validation

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Validating Measures of Corporate Control

What do you observe in the figure below?



Validating Measures of Corporate Control

What is an incremental R² measure?

Prior literature supports validation variables

- Innovation; ln(Patent), R&D Spending, Innovation Strength
 - ln(Patent) is the natural logarithm of one plus the number of patents filed and eventually granted in one year
- Integrity (malfeasance in accounting and backdating executive options grants); Restatement, backdating
- Quality; product quality, product safety, top brand
- Respect; diversity, 'best employer'
- Teamwork; employment involvement, number of joint ventures/strategic alliances
- OLS (ln(Patent), R&D Spending, diversity, number of JV/SA), Probit (Remainder)

A. Validating the cultural value of innovation

	ln(Patent) (1)	ln(Patent) (2)	ln(Patent) (3)
Innovation	0.183*** (0.018)	0.183*** (0.018)	0.098*** (0.017)
Size	Yes	Yes	Yes
ROA	No	Yes	Yes
Ind FE/yr FE	No	No	Yes
Intercept	Yes	Yes	Yes
Obs.	25,298	25,298	25,298
R ² /pseudoR ²	.036	.036	.166
Incremental R ²	.0301	.0303	.0075
Incremental pseudoR ²			

Author's control for size, ROA, industry, and year effects

Validating Measures of Corporate Control

Can the authors justify the use of their measures?

Justifications loosely support measures

- Authors raise concerns regarding markers testing the corporate measures redundant from high correlations. They address these concerns through the following:
 - Corporate culture could be an aspiration yet to bear fruit in firm policy, performance, with firm culture
 - The markers are much narrower than what the value embodies
 - Data coverage and quality of corporate culture measures are far better than those for most markers
- Use other measures of corporate culture
 - Full transcripts/Glass Door/Topic Modelling
 - What are the issues with these methods?
- Investigate self promotion in calls using measures to detect positive/negative emotions, and word with multiple senses. High correlations in both investigations imply no significant role played



Corporate Finance Applications

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Implications on Corporate Culture

Hypothesize the practical use of a strong corporate culture?

Authors hypothesize various business outcomes

- Surveys questioning North American CEOs and Chief Financial Officers (CFOs) provide a view corporate culture as one of the top-three factors affecting firm's value, while posturing cultural fit is integral to M&A success
- Authors attempt to empirically examine the implications of having a strong corporate culture on business. They explore:
 - Business Outcomes e.g., Tobin's Q
 - Performance in bad times
 - Mergers & Acquisitions
 - Fit and/or conflict
 - Acquisitiveness
 - Merger pairing
 - Post-merger acculturation



Implications on Corporate Culture

What is Tobin's Q? What does it measure?

Tobin's q	
	(8)
Strong culture _(t-1)	0.043*** (0.009)
Firm-level controls	Yes
Ind FE/yr FE	Yes
Intercept	Yes
Obs.	48,750
R ²	.687
Strong culture _(t-3)	0.048*** (0.009)
Firm-level controls	Yes
Ind FE/yr FE	Yes
Intercept	Yes
Obs.	36,954
R ²	.712
Strong culture _(t-5)	0.053*** (0.010)
Firm-level controls	Yes
Ind FE/yr FE	Yes
Intercept	Yes
Obs.	27,302
R ²	.726

Do these positive correlations make sense?

	Abnormal return (1)	Abnormal return (2)
Strong culture	-0.012*** (0.003)	-0.004 (0.004)
Strong culture × Financial crisis	0.028*** (0.005)	0.024*** (0.005)
Strong culture × BP oil spill		
Firm-level controls	Yes	Yes
FF3 factor loadings	Yes	Yes
Yr FE	Yes	Yes
Firm FE	No	Yes
Intercept	Yes	Yes
Obs.	22,092	22,091
R ²	.018	.021

Is this feasible for financial companies?

Strong culture is an indicator variable that takes the value of one if the sum of a firm's five cultural values is in the top quartile across all Compustat firms in a year, and zero otherwise

Implications on Corporate Culture

What makes a successive acquisition?

Acquisitiveness, merger pairing, acculturation

- Authors form the following hypotheses”
 - Cultural fit: Differences in corporate cultures of firm-pairs are a key determinant of deal incidence
 - Acculturation: Predicts merging firms with different cultures will develop a jointly determined culture
 - Apply cultural similarity (cosine) and cultural difference measures (Euclidean distance) to explore hypotheses
- Explore a new dataset of 7,773 completed deals from Jan 1, 2003, to Dec 31, 2018
- Linear probability models (LPM) and Conditional logit models (Clogit) predict acquirers across three subsets - Compustat population, Industry/size matched, Industry/size/BM matched

Variable	<i>A. Corporate cultural values and acquisitiveness</i>	
	Full sample	LPM (1)
Innovation	0.004** (0.002)	
Integrity	-0.045*** (0.005)	
Quality	-0.008*** (0.003)	
Respect	0.015*** (0.002)	
Teamwork	-0.000 (0.003)	
Firm size	-0.002** (0.001)	
Leverage	-0.028*** (0.008)	
ROA	0.137*** (0.009)	
Sales growth	0.054*** (0.004)	
Past return	0.023*** (0.003)	
Top-5 institutions	0.169*** (0.011)	
Ind FE/yr FE	Yes	
Deal FE	No	
Intercept	Yes	
Obs.	53,545	
<i>R</i> ² /pseudo <i>R</i> ²		.047

Assesses the probability of being an acquirer

What do the negative coefficients imply?

Implications on Corporate Culture

Is there sufficient evidence to support both hypotheses?

B. Cultural fit and merger pairing

Variable	Industry and size-matched	
	Clogit (1)	Clogit (2)
Cultural similarity	4.305*** (0.902)	
Cultural distance		-0.496*** (0.075)
Acquirer characteristics		
Firm size	2.634*** (0.210)	2.680*** (0.210)
Leverage	-1.062*** (0.342)	-1.153*** (0.350)
ROA	-0.077 (0.566)	-0.223 (0.581)
Sales growth	0.355** (0.169)	0.398** (0.168)
Past return	0.164 (0.142)	0.153 (0.147)
Top-5 institutions	1.645*** (0.442)	1.665*** (0.432)
Target characteristics		
Firm size	2.090*** (0.299)	2.064*** (0.300)
Leverage	0.062 (0.307)	-0.113 (0.307)
ROA	-0.585* (0.308)	-0.605** (0.306)
Sales growth	0.321** (0.141)	0.323** (0.141)
Past return	-0.053 (0.092)	-0.035 (0.095)
Top-5 institutions	2.783*** (0.379)	2.818*** (0.381)
Deal characteristics		
Same state	0.928*** (0.147)	0.925*** (0.148)
HP similarity	26.551*** (2.058)	26.661*** (2.035)
Deal FE	Yes	Yes
Obs.	5,682	5,682
Pseudo R^2	.295	.300

Cultural similarity examines the relation between cultural fit and acquirer-target firm pairing (binary; 1,0), estimated from 594 completed deals.

Acculturation after deal completion, using OLS regressions, for one and three years after the deal, without engaging in another significant deal, using 492 and 335 completed deals, respectively. Target-specific values regressed on acquirer values in the year prior to deal announcement

	C. Post-merger acculturation									
	Innovation _{t+1} (1)	Innovation _{t+3} (2)	Integrity _{t+1} (3)	Integrity _{t+3} (4)	Quality _{t+1} (5)	Quality _{t+3} (6)	Respect _{t+1} (7)	Respect _{t+3} (8)	Teamwork _{t+1} (9)	Teamwork _{t+3} (10)
Acquirer innovation	0.854*** (0.039)	0.905*** (0.053)	0.030** (0.014)	0.042** (0.020)	0.026 (0.028)	0.059 (0.041)	0.049* (0.027)	0.043 (0.036)	0.035* (0.021)	0.072*** (0.025)
Target-specific innovation	0.108*** (0.034)	0.108** (0.052)	0.003 (0.014)	0.022 (0.021)	-0.010 (0.025)	-0.049 (0.038)	-0.022 (0.023)	-0.028 (0.033)	-0.002 (0.018)	-0.014 (0.027)
Acquirer integrity	0.027 (0.107)	-0.050 (0.161)	0.552*** (0.051)	0.506*** (0.063)	-0.038 (0.077)	-0.077 (0.101)	0.073 (0.073)	0.026 (0.096)	0.043 (0.063)	-0.047 (0.079)
Target-specific integrity	-0.038 (0.086)	-0.043 (0.132)	0.069* (0.041)	0.112* (0.058)	-0.002 (0.070)	0.040 (0.100)	0.074 (0.061)	0.065 (0.101)	0.045 (0.048)	0.067 (0.068)
Acquirer quality	0.074 (0.048)	0.067 (0.083)	0.041* (0.022)	0.044 (0.033)	0.841*** (0.032)	0.790*** (0.048)	0.077*** (0.029)	0.108** (0.053)	0.073*** (0.026)	0.090** (0.037)
Target-specific quality	-0.001 (0.035)	0.064 (0.052)	-0.008 (0.016)	-0.003 (0.023)	0.099*** (0.028)	0.154*** (0.041)	-0.034 (0.026)	-0.034 (0.037)	0.015 (0.020)	0.027 (0.030)
Acquirer respect	-0.104** (0.052)	-0.196** (0.077)	0.002 (0.022)	-0.001 (0.033)	0.035 (0.044)	0.014 (0.060)	0.766*** (0.040)	0.685*** (0.064)	-0.013 (0.033)	0.006 (0.044)
Target-specific respect	0.085** (0.043)	-0.012 (0.064)	-0.036* (0.021)	-0.068** (0.031)	0.024 (0.033)	0.044 (0.053)	0.094*** (0.029)	0.092** (0.046)	0.025 (0.023)	-0.039 (0.033)
Acquirer teamwork	0.064 (0.076)	0.079 (0.105)	-0.003 (0.031)	-0.038 (0.042)	-0.025 (0.044)	-0.036 (0.067)	-0.013 (0.051)	-0.071 (0.082)	0.684*** (0.042)	0.562*** (0.049)
Target-specific teamwork	-0.071 (0.044)	-0.135* (0.069)	0.029 (0.021)	-0.020 (0.032)	-0.001 (0.034)	-0.001 (0.058)	-0.016 (0.031)	-0.054 (0.051)	0.081*** (0.025)	0.200*** (0.044)
Acquirer/target/deal controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind FE/yr FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	492	335	492	335	492	335	492	335	492	335
R^2	.806	.780	.538	.472	.807	.761	.746	.707	.717	.679

Concluding Comments

Connor McDowell

Conclusion

Can you measure corporate culture? Does it matter?

ML is useful for measuring corporate culture

- Introduce the word embedding model as a new approach to quantifying the meaning of expressions
- Propose a new semi-supervised machine learning approach for textual analysis to reap benefits from supervised and unsupervised
- Obtain scores for five corporate culture values: innovation, integrity, quality, respect, and teamwork
- Validate measures and attempt to correlate corporate culture to business outcomes, M&A Activity
- Machine learning holds promise for more applications in social science



Strengths & Weaknesses

What are additional strengths and weaknesses?

Paper has several strengths and weaknesses

- **Strengths**
 - Comprehensive dataset
 - Novel methodology to measures semantics within documentation
- **Weaknesses**
 - Validation tests not too thorough
 - Inconsistencies when applying corporate culture measures to business outcomes i.e., business performance
 - Industry/fixed effects explain changes in scores
 - Misalignment between autocorrelations and business performance

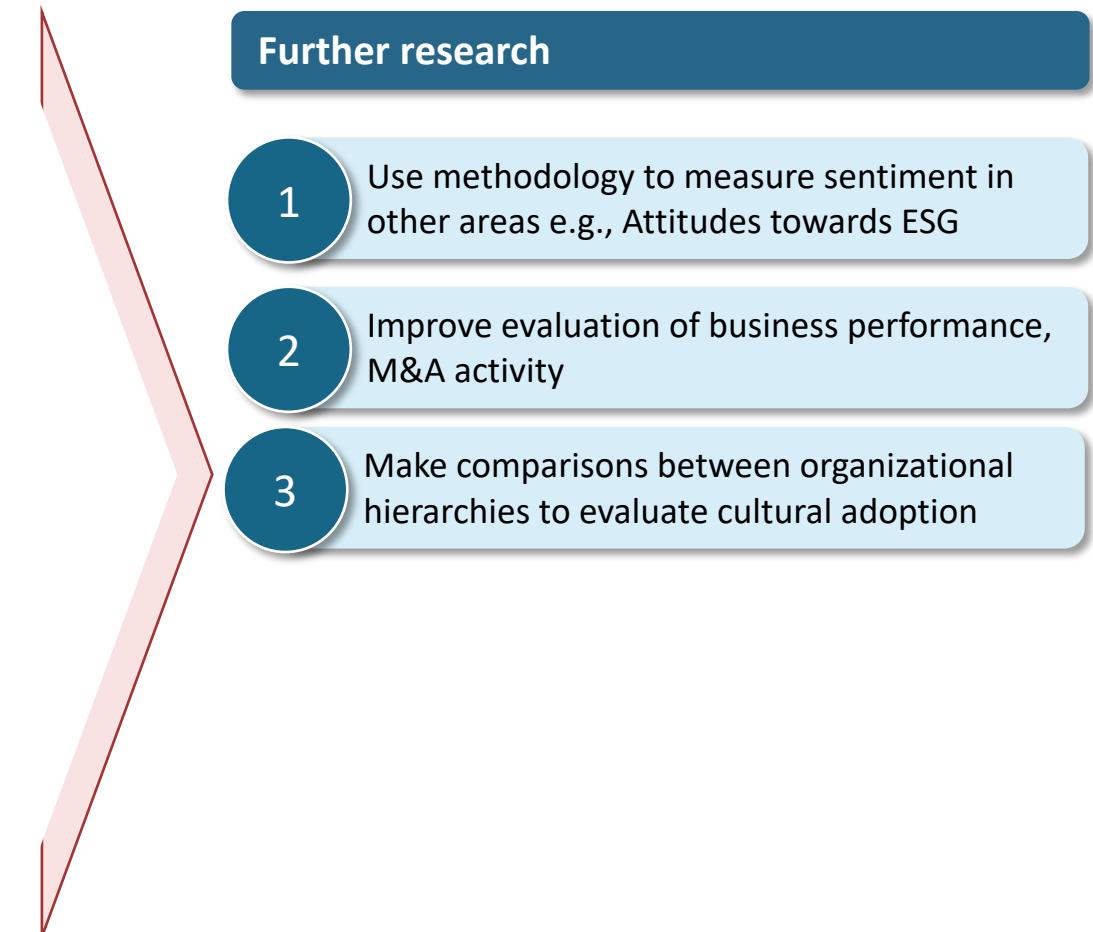


The Good Place

Literature Review & Future Research

There has been a limited number of articles implementing Natural Language Processing (NLP) algorithms to measure corporate culture

- 1 **Corporate Culture**
O'Reilly, Chatman 1996; Graham et al, 2018
- 2 **Textual Analysis**
Loughran, MacDonald 2016
- 3 **Collocations and Corporate Disclosures**
Routledge, Sacchetto, Smith 2018
- 4 **Word Embedding Models**
Harris, 1954
- 5 **Relationship between Culture and M&A**
Graham et al., 2018
- 6 **Empirical Asset Pricing via Machine Learning**
Shihao Gu, Bryan Kelly, Dacheng Xiu, 2020





Thank you