# **Employee Survey Analysis**

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# **Contents**

Semantic Text Analysis	4
Quantitative Models.	5
Unstructured Text Analysis.	7
Taxonomy Classification	9
OLAP Charts	12
Summary	12

Text mining tools provide the ability to take unstructured data in the form of digitized text, and translate this data into useful knowledge. Semantic text analysis combines quantitative computer support with expert experience to process text data qualitatively. This can give new views of data that can lead to human insight. This paper demonstrates the process by which PolyAnalyst can take employee survey data and develop business taxonomies showing the logical organization of responses, making it easier to see the views held on each issue along with their relative support.

The data context in this case is employee survey data, an extract of which is shown in Figure 1.

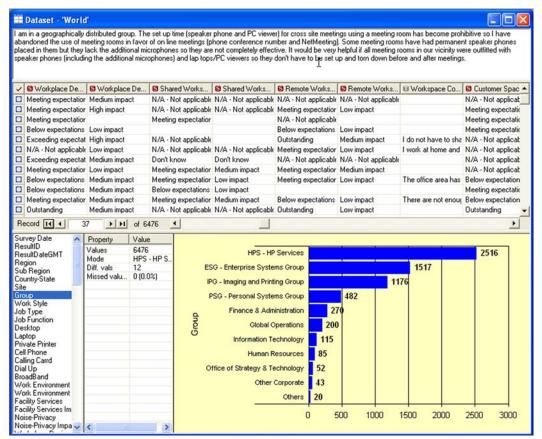


Figure 1: Employee Survey Data

An example survey response is shown in the top window. In this case, the respondent is explaining why meeting room technology was not used, pointing out the simple enhancements needed to make meeting room technology more effective. The dataset includes 105 attributes reflecting profile characteristics of respondents, demographic data, time data, and both structured and open-ended responses for 6,476 entries. One of these attributes, "Group," is displayed in a histogram. About 2,500 of the responses came from HP Services, for example. The window on the lower left indicates some of these 105 attributes. Structured responses can be dealt with by traditional data mining techniques. There is a great deal of information, however, available in the unstructured text data. PolyAnalyst software tools provide the ability to tap into this useful source of knowledge.

## Semantic Text Analysis

This paper's aim is to demonstrate the process through which unstructured text data is converted to useful knowledge. PolyAnalyst Text Mining software includes user dictionaries, which can be edited for each specific study. Figure 2 shows the primary window to access a user dictionary.

unaform		Alternatives:	11	
Expansion	Active	Expression	Agegular	Case
bicle		cube	0	0
orkspace		cubical cubicile	0	0
		Find alternative     Find transform     Ford transform     Show all		
		cube		

Figure 2: User Dictionary

An important step is to enter items to be ignored, eliminating common terms that are not interesting in this particular study. The semantic dictionary keeps track of important terms in a variety of forms, both by different forms of root words, as well as synonyms. A basic semantic lexicon is part of the system, but the user can enhance this resource for particular studies. Once dictionary settings are made, the system can count the number of occurrences of key words. Figure 3 shows text analysis results for workspace comments in the employee survey database.

Rule name	Rec Count	%
Workspace Comment_noise	335	50.99
Workspace Comment_workspace	163	24.81
Workspace Comment_office	156	23.74
Workspace Comment_people	144	21.92
Workspace Comment_area	103	15.68
Workspace Comment_privacy	131	19.94
Workspace Comment_phone	136	20.7
Workspace Comment_noise level	74	11.26
Workspace Comment_desk	75	11.42
Workspace Comment_meeting room	76	11.57
Workspace Comment_space	95	14.46
Workspace Comment_environment	116	17.66
Workspace Comment_meeting	92	14
Workspace Comment_room	126	19.18
Workspace Comment_conversation	72	10.96
Workspace Comment_due	47	7.154
Workspace Comment_cubicle	42	6.393
Workspace Comment_customer	39	5.936
Workspace Comment_meeting call	37	5.632

Figure 3: Text Analysis Results

It can be seen that workspace comments included semantic variants of noise in 335 records, almost one-half of the almost 700 records with workspace comments. This list guides the analyst to identify workspace features that triggered comment by those surveyed. Some comments addressed workspace (or office) in general. The next most common term related to people. Specifics for any particular phrase among workspace comments can be selected, allowing the user to drill down to more details. Those comments relating to workspace distractions can be gathered in a subset of the data. There were 163 such records. The analyst labeled this data subset as "Workspace Distraction." Figure 4 shows drill-down results for the phrase "workspace" in the workspace comment attribute.

Drill-down results in d	lataset Workspac	e Distraction on	column Work 🔀
III III III III IIII   IIIII   IIIIII		■ ■	
✓ ■ Workspace Co	😂 Survey Date	S ResultID	🕖 ResultDate 🔺
☑ Lighting is an issue.	EISS#3-Oct03	1034	10/6/2003
The environment is	EISS#3-Oct03	107	10/4/2003
🗹 My work area is usu	EISS#3-Oct03	1083	10/6/2003
🗹 We live in cubicles,	EISS#3-Oct03	1095	10/6/2003
☑ We have been told	EISS#3-Oct03	1140	10/6/2003
🗹 Cube walls are too li	EISS#3-Oct03	1181	10/6/2003 🖵
Record II 4	▶ ▶ of 1	63 •	
The environment is very most of my work with hea Workspaces are pretty g workstations that are in c	adphones to block of ood except they are	ut the noise. not deep enough f	an mar a se

Figure 4: Distraction Drill-Down Results

The second line in Figure 4 relates to a comment made in October 2003 relating to noise in the environment, blaming the high number of cubicles in the room. However, this employee has coped with the noise problem through the use of headphones. Thus, the conclusion of this subject is that workspace would be acceptable, given sufficient depth to allow dual-headed workstations. The ability to drill-down enables the analyst to make more sense of what subjects are trying to say relative to noise or any other workspace comment key word.

#### **Quantitative Models**

PolyAnalyst includes a number of data mining tools that can be used to quantitatively analyze data. For instance Figure 1 above showed a distribution chart. Figure 5 shows a distribution chart for the attribute "Work Environment," which includes 5 possible values, as well as "Don't know" and "Not applicable."

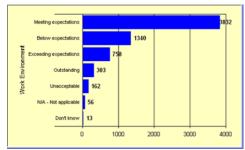


Figure 5: Distribution Chart

The distribution chart provides a quick view of the number of responses for each attribute value. Most survey responses were satisfied with current conditions, but about 1,250 felt that the work environment was below expectations. Work environment opinions in this database can be evaluated longitudinally, as survey data is available over the period October 2003 to February 2004. Figure 6 shows trends for the attribute "Work Environment" over time.

III Histogr	ram - Work Environment Trend	k
	Work Environm	ment Trend
1400	$\sim$	
1200 -	/	
1000 -		
800 -		Work Environment: Meeting expectations     Work Environment: Below expectations
		- Work Environment: Exceeding expectations
600 -		<ul> <li>Work Environment: Outstanding</li> <li>Work Environment: Unacceptable</li> </ul>
400 -		Work Environment: Onit know     Work Environment: N/A - Not applicable
200 -		
0 -	RSS#3-Oct03 RSS#4-Dec03 RSS#5-Feb04	
	Survey Date	

Figure 6: Trend Chart

Link charts enable analysts to view the correlation among attribute values. Figure 7 shows those combinations of attribute values for "Region" and "Work Environment" that have strong correlations. The boldness of the arcs linking attribute value also provides a representation of strength of correlation.

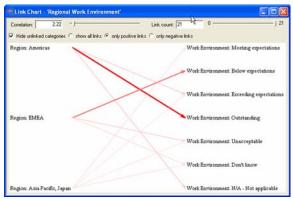


Figure 7: Link Chart Across Attributes

The PolyAnalyst software includes the ability to generate decision trees of association rules. Figure 8 shows such a decision tree.

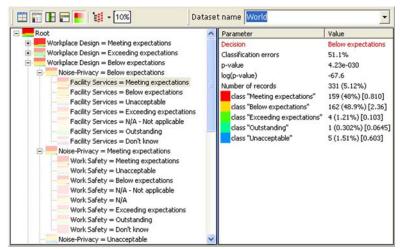


Figure 8: Decision Tree of Work Environment

In this case, if "Workplace Design" has an attribute value of "Below expectations," and noise-privacy has a value of "Below expectations," there were 333 records (5.12% of the 6,476 total), among which 1.51 percent were rated as unacceptable on attribute "Facility Services," 48.9 percent were below expectations, 48 percent met expectations, 1.21 percent exceeded expectations, and 0.302 percent were rated as outstanding. The analyst here selected the subgroup with the Facility Services rating "Meeting expectations," and those records are displayed in the lower right window. The user can view these approximately 160 records in detail. In general, however, the most common rating when workplace design and noise-privacy were below expectations was that facility services were also below expectations.

#### **Unstructured Text Analysis**

Text mining software's value in dealing with unstructured text can be demonstrated here. First, keywords are identified. Figure 9 shows the count of records with those keywords displayed.

Figure 9: Keywords

Of those keywords displayed, "office" showed up in 438 records (6.76 percent of all 6,476 records). The software can display a tree of these keywords, as exhibited in the left window of Figure 10.

Categorization Tree				
🖽 🖪 🖼 🛏				
<pre>workspace(335) office(309) manager(14)   \$\$others(295) conversation(43)   co-worker; colleague; workfellow; fellow worker(4)</pre>	Workspace Co     Workspace Co     I am working in a op Flex desk first floor     Flex desk first floor     Record I I I I am working in a open environmnent. People d (the floor is not "carpeter it is not so easy to have conversation of the coll question of habit. Some that is not simply accept in an open space", woo Another point is that my if some actions have be these actions are not sur removed. I do not know	Sourcey Date     EISS#3-Oct03     EISS#3-Oct03     EISS#3-Oct03     EISS#3-Oct03     I	So ResultID     2025     484     484     control of the test of test	the steps on the floor econf. Quite frequently, an example : if a less disturbed by the voice. It is also a er on the phone. And the topic : "How to work the coffee corner). Even to onto the <b>desks</b> part,

Figure 10 : Category Development

Here there were 43 occurrences of the key word "conversation, four of which involved coworkers or its synonyms. Two of these contained the key word "desk," which was selected by the analyst. These two records are shown in the upper right window. The first of these is selected, and the lower right window displays the survey response, with key words highlighted in coded color. Figure 11 shows further drill-down results for six records of 389 relating to key word "workspace."

Workspace Comment	Region	Job Type	Job Function
sometimes have to take conference calls from home due to the noise in the area. It's just the world of cubicles versus office.	Americas	Individual Contributor	Information Management
We live in <b>cubicles</b> , it's noisy, and there is no privacy. Why even ask that question? The crappy cubicle-attached furniture we've been forced into is completely inadequate for R&D usage There is insufficient space for multiple computer systems (a requirement for R&D), the cubicle attached desks are unstable and make loasy work surfaces, the cheap under-desk drawers are so filmsy, they frequently fail on the floor when I try to slide them in & out (so mostly, ljust store stuff on top of my desk, since it's too unstable to be used as an actual desk anyway).	Americas	Individual Contributor	Engineering
We have been told that we are not allowed to move our work-space. There are people that had to move due to their teams moving, but they were not accomodated with phones, computers, etc for more than a year. The rule of not moving no matter what the curcurentances is just plain rediculuous; it simply prohibits productivity is some situations. In my aisle, we have many empty calibles. We would like to organize our work environment to the highest potential, to reduce noise and non-work related interuptions. We cannot do this at this time, it would be nice to at least give some future date of when the moves will be allowed and how much freedom we have in designing our own workspace.	Americas	Individual Contributor	Engineering
Somewhat noisy when alot of people are in the office because the cubicles are close together with low walls. I usually try and find a private room for important phone calls.	Americas	Individual Contributor	Systems Integration
There are some people that hold con-calls or meetings in their cubical and it can be very distracting due to speaker phones and the vocal levels that are reached on occasion.	Americas	Individual Contributor	Business Planning
The low wall design of the cubicles makes for a noisy work environment. Also, the chairs provided do not offer adequate support.	Americas	Individual Contributor	Finance
Area has become very cramped. New inhabitants keep computers on full volume, shout back and forth, scream into cell phones, and hold conference calls or meetings in cubicies on full volume. One guy even leaves his speaker phone on full plast in a conference and LEAVESI (Sounds of allot nor or disconnected line echo throughout Terrace)	Americas	Individual Contributor	Outsourcing Management
Cubicles are small and close together. It is very difficult to have private conversations with customers or employees. Noise is apparent to customers from others near my workspace. Cubicles are old and in need of thorough cleaning. Need drawers or cabinets that are casable of beina locked.	Americas	Manager / Supervisor	Sales Operations

Figure 11 : Drill-Down on Key Word

This also is color coded to quickly guide the user to key terms.

## **Taxonomy Classification**

A taxonomy classification can be developed through a general process. Those terms important to a specific study can be identified, based upon survey responses. In Figure 12, the left window displays a set of well-defined categories used to group terms defining subsets.

C Special Areas (767)	V Workspace Co	BenultD	ResultDateGMT	B Region	
Touch Down Areas (28)     Hotel Areas (39)	High speed fast thrc		228/2004	Americas	1
Meeting Rooms (259)	Since I am working		2/2/2004	Americas	-
Quiet Rooms (91)	I The equipment and		2/2/2004	Americas	
\$\$0thers (407)	I have just received		2/2/2004	Americas	
C Equipment (524)	Droblem to receive h	3316	2/2/2004	EMEA	
C Internet/Network (159)	The on Site service:	3252	2/2/2004	Americas	
Network (103)	My home-office is w	3217	2/2/2004	EMEA	
Speed (37)	I The quality of the ne	3155	2/2/2004	EMEA	
Availability (13)	Problems with the la	2941	2/2/2004	EMEA	
\$\$Others (33)	D There is absolutely r	2905	2/2/2004	Asia Pacific, Japan	
Privacy (268)	Having two domains	2852	2/2/2004	Asia Pacific, Japan	
Distraction (657)	When I go into the a	2752	2/1/2004	Americas	
- Sounds (604)	d the internet process	2664	1/31/2004	Asia Pacific, Japan	
- Lighting (21)	Noise due to construit	2544	1/30/2004	Americas	
Smell (5)	When not in home r	2540	1/30/2004	Americas	*
- \$\$Others (49)	Record II 4 1	2 + + I of	37 4	,	1
Visitors (48)	N. A. L. L. M. W.	6 4 4 4 4		1.01	
Visitors (+6) Scheduling (16) Phone Calls (84) Furniture (419) Desis / Tables (87) Chairs (62) Ergonomics (16) Stothers (271) Floor (83)	When I go into the office reserve space, that is no a office without a Lan ja plus I'm more productive The only thing that cou home. Since I work with assigned IP's) proves to	t possible. Also, th ick or a phone. Th there. Id be done is to giv external vendors v	ere's been more than o at's why I choose to wo ve me HIGHER <mark>speed</mark> who tie access to an IP.	nce that I've ended u ork at home so much; access and static IP's	ip in

Figure 12: Taxonomy Classification

The analyst has selected the term "Speed," a subset of workspace comments involving "Internet/Network." There are a total of 37 such records, the first 11 of which are displayed in the upper left window. The first, record number 268 is selected, and the full comment displayed in the lower right window. Key terms are highlighted by color. Development of this taxonomy can guide the analyst to identify key issues.

This process can focus on key issues. For instance, 657 of the total 6,476 comments involved workspace distractions. These 657 records were exported for detailed analysis. Figure 13 displays the first three of these comments.

Project:	HP Employee Survey Analysis			
Join Type:	Single			
Number of Records: 657				
Export Date: 07/01/04 15:11:41				
Generator: PolyAnalyst 4.6.500				
Workspace Comm	and the second se	Region	Grouip	Job Function
	rg facility is far too noisy and does not seem to have adequate noise dampening qualities.	Americas	HPS - HP Services	Customer Service/Support
The desks are standing concentrate on the wor	to near by each other, the noise during the day is therefore very high. It is hard to k.	EMEA	HPS - HP Services	Sales Operations
The main dissatisfaction	is related to the noise and privacy of the environment.	Americas	HPS - HP Services	Sales
The <b>noise</b> generated by Also as a manager, the	eeting rooms, we have started to use cubes adjacent to individual cubes as meeting areas. these open meeting rooms are quite disruptive to people atting adjacent to these rooms. re are many impromptu discussions of sensitive matters. However, there is no privacy in gein ever me may overhear these conversations.	Americas	IPG - Imaging and Printing Group	Engineering
use our speakerphones	round me are on conference calishet-meetings throughout the day. This includes me. We all and the holse is somewhat distracting, even with all of our doors closed. I think phones would be a plus.	Americas	Global Operations	Business Planning
the office is too loud, to	o full, there is no privacy whatsoever.	EMEA	ESG - Enterprise Systems Group	Sales

Figure 13: Export of Records Focusing on Distractions

Noise is apparent in these three comments. Other distractions identified from other records include poor lighting, and bad smell. Analysis can look at other factors related to distractions. Figure 14 shows a link chart showing key terms related to workspace comments.

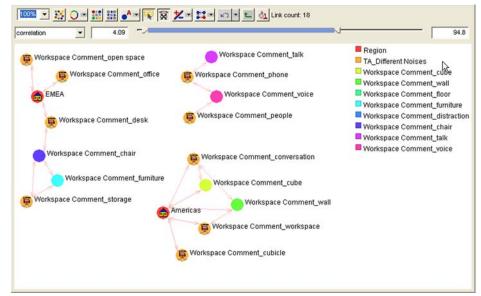


Figure 14: Link Chart of Distraction Comments

This link chart is also color coded, with key on the upper right. Two regions show up. In the Americas, comments relate to noise in cubicles, conversations, and workspace in general. Other strong correlations show up for cube and walls. In area EMEA, comments relate to noise, associated with desks, offices, and open space. Figure 15 shows key correlations among this subset of data.

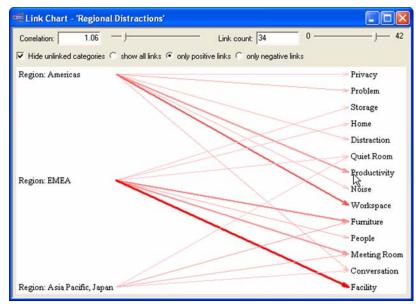


Figure 15: Correlation Links

Strongest correlations displayed in the Americas are with the workspace, and productivity. Strongest correlations in the EMEA region are with facilities, furniture, and meeting rooms. Figure 16 shows an additional quantitative tool, a snake chart.

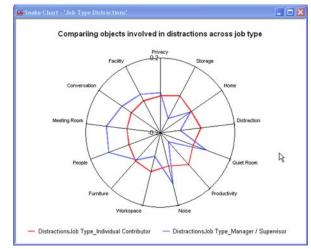


Figure 16: Snake Chart

The snake chart displays correlations visually on multiple (here 13) dimensions, with stronger correlations graphed at greater distance from the center. Two attributes were selected for display on this snake chart (distractions reported by individuals, and distractions reported by managers). Managers had fairly equal correlations with all thirteen distractions graphed. Individuals had lower correlations with storage and workspace, and less reported impact on productivity and distractions than did managers). The analyst can drill down to reports such as shown in Figure 17.

	# # (+·»		≞≞		
~	B Meeting Room	S Remote Works	S Remote Works	Workspace Co	•
	True	N/A - Not applicable	N/A · Not applicable	There does not seer	
	True	Unacceptable	Low impact	49D and 49C are le-	
	True			privacy and noise. I	
	True	<b>Below</b> expectations	Medium impact	1. We lack meeting	-1
	Тпю	Relow expectations	Madium impact	Conference roome =	-
Re	ecord II 4 2	> > > of 36		•	
not pro	have a number of the	buildings across from e facilities found in the rooms. Many confere Office cubes have low	e main campus such a ence rooms have prob	plems with projector	

Figure 17: Drill-Down Report for Distractions by Managers

The snake chart, supplemented by specific reports obtained by drilling down, indicates that managers complain about difficulties in meetings, while individual employees complain more about lost productivity due to noise.

#### **OLAP Charts**

The text analysis of generated key terms can then be used to sort out the data by selected attributes. This is demonstrated in Figure 18, which shows who is affected by noise, how they are affected, and where.

Stilliservice         Stillise		straction(A)	Job Function(D)	Distraction Object(A	Regio	(D)	Country-State(D)	Group(D)	
STRAINLEY (10)Engineering (10)partition or wall or subcle or cubcle or cubcles (10)particular/(17)Callania     The State (10) and the state of	483Lighting 5(Smell	(41) (75) (22) (3) (3) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7	Information Manag Lustomer Service/ Administration scritties Human Resources taining Deprotors Sales Deprotors Sales Deprotors Sales Aknown Systems Integratio Systems Integratio Systems Integratio Unitsourcing Mana	ISSENDANCE and the set of the set	12/EMEA		(2)Texas (4)Idaho (1)Oregon	(4)IPG - Imaging an (1)PSG - Personal !	nd P Syst
Image: Control Set (Internet Control Internet Control C							-		3
Annotat Caltonia Engineering Mit Name Seen 1047     Stat 20:003 1140 10:6/2003 EAY     Annotat Caltonia Engineering 4/0 and 4/2 an 6 (55:81)-0:03 1140 10:6/2003 EAY     Annotat Caltonia Engineering The noise Nevrill 15:51:83)-0:03 1502 10:07/2003 EAY     Annotat 15:51:83)-0:03 1502 10:77/2003 EAY				abce or cube or cubical	e or cubicles=>(30)	Americai+)	(1/)Lalforna		
Americas California Engineering 410 and 49C are le EISS#30ct03 1315 10/6/2003 BAV     American California Engineering The noise levels in 1 EISS#30ct03 1602 10/7/2003 IPG	- BRegion	Country-State	Job Function	Li Wokipace Co.	Survey Date	Bes	ND Besult	ateGMT Sub Region	
Americas     Colifornia     Engineering     The noise levels in 1     EISS#3.0x803     1602     10/7/2003     IPG	Americad	California	Engineering	We have been told	EISS#3-Oct03		10/6/200	3 BAY	-
	Americas	Colifornia	Engineering	49D and 49C are le-	EISS#3-Oct03	1315	10/6/200	3 BAY	
	Americas	California	Engineering	lack of conference a	EISS#3-Oct03	318	10/6/200	) IPG	
Record te 4 1 • • • of 17 •	Record H 4	1 + H of	17 •						

Figure 18: OLAP Chart

The analyst can select the header attributes. In this case, of the 6,476 comments in the database, 576 related to noise (48 to lighting, 5 to smell). The analyst here has selected "Noise" for further analysis by job function. Of the 576 comments relating to noise, 103 involved engineers. Of those 103, 33 involved partitions or walls. Of those 33, 30 were from the Americas region, 2 from the EMEA region, and 1 from the Pacific. Of the 30 from the Americas region, 17 involved California. The analyst could search by group, but here those 17 records are available for detailed review. The first is displayed in the bottom window, with key terms highlighted by color.

In this case, the data indicates that engineers in California want better cubicle dividers to reduce noise. This is a demonstration of discovered knowledge, something that the user or analyst would not have known to expect without going through the process of text analysis.

#### Summary

Text mining using PolyAnalyst software is supported by quantitative and qualitative tools. Quantitative support begins with visualization, providing histograms, pie charts, bar charts, and snake diagrams to show the relative density of key terms. Other quantitative support is provided by correlation models, through link charts, and decision trees sorting key terms. Qualitative support is provided by the process of identifying keywords, which are categorized by the software, and a series of reports of subsets of data selected by the analyst. This leads to development of business taxonomies, which can lead to better understanding of survey data than would be possible by traditional methods where all variables have to be set up prior to analysis. In this example, focus on the concept of distraction led to identification by region and job category. Analysis of the OLAP dimension matrix revealed support for issues such the inadequate cubicle walls, mostly affecting engineering and customer service staff.

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