

## Two-way Survey Analysis for Units and Organization with Means and Percentages Favorable and Unfavorable

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### ABSTRACT

Employee turnover costs business millions of dollars annually. While customer satisfaction surveys are frequently administered and evaluated, employee satisfaction is often neglected. In fields such as medicine and education, retention of key employees such as nurses and teachers is mission critical. One Florida school district with over 40,000 students and over 5000 employees surveys teachers twice yearly and uses Enterprise Guide® software to produce detailed analysis of 33 questions for over 40 different worksites. Separate surveys for 24 departments are also distributed twice a year to school leadership and the returns analyzed to evaluate organizational-wide services and support. Although the techniques are the same, only the larger teacher survey is discussed in this article. Basic to intermediate level SAS users should find something new and applicable to any business seeking to improve employee satisfaction.

### INTRODUCTION

Separation costs, recruitment efforts and pre-employment screening and create otherwise avoidable business interruptions and expense. When managers provide a comfortable environment, employees are less likely to seek other employment. The converse is also true. Finding and resolving issues and areas of dissatisfaction by employees can create workspaces where essential workers are more likely to be retained. For large organizations, recognizing problem areas and retraining managers to respond quickly and appropriately to make changes to workplace practices and perceptions may substantially affect employee satisfaction and turnover.

Having a tool to identify problem areas across the organization and within departments is paramount to reducing dissatisfaction and maintaining a stable workforce.

The processes below apply input, output, and if-then statements; an occasional do loop; sorting, Proc Report and Proc Sgpanel statements and other processing steps.

### THE PROBLEM

“People leave managers, not companies” (Buckingham & Coffman, 2014)

Businesses and organizations with multiple sites and departments conduct surveys to determine levels of employee satisfaction and other measures. Without a means to disaggregate the data by individual units, all the results are applied to the entire corporation. Serious problems in one or more localities or functions may be masked by the preponderance of data from other well-functioning areas that masks these issues.

We have all seen news reports of the actual physical damage a single employee can do to a workplace, and other instances of social media and electronic activity that detract from the institutional reputation or expose data security weaknesses.

Identifying potential trouble areas, signs of mismanagement, poor leadership, or issues of concern can prevent small irritants from becoming large and costly organizational problems. Having the data reported by units and for the entire surveyed population clarifies whether remediation requires local or global reaction and correction.

# PROPER DATA DISAGREGATION IS THE SOLUTION

Choosing and examining selected data elements that allow for the greatest degree of confidence in reports to top management is a key part of the procedure. After preparing, distributing, collecting and reporting the survey questions, thousands of data points need to be converted into reports that are easily understood and clearly illustrate both high and low performance.

## DATA COLLECTION

The data in this example includes only the work location and the responses to the thirty-three questions. The survey tool only reports out the location and the question text in the column headers and the responses as text in the rows.

Figure and Table 1 below show a partial view of the format of the survey and the initial report from the survey instrument. The red asterisk indicates to the respondent that the question requires an answer.

**Figure 1. Selected Survey Questions**

1. Please select your school \*

- Select -

2. Teachers and staff work in a school environment that is clean and well maintained. \*

Strongly Agree

Agree

No Opinion

Disagree

Strongly Disagree

3. The school is a safe environment for teachers and staff to work. \*

Strongly Agree

Agree

No Opinion

Disagree

Strongly Disagree

4. There is an atmosphere of trust and mutual respect. \*

Strongly Agree

Agree

No Opinion

Disagree

Strongly Disagree

**Table 1. Truncated Sample of Initial Survey Input File**

school	Teachers and staff work in a school environment that is clean and well maintained.	The school is a safe environment for teachers and staff to work.	There is an atmosphere of trust and mutual respect.	Teachers feel comfortable raising issues and concerns which are important to them.
Sch1	Disagree	Agree	Agree	Agree
Sch2	Agree	Agree	Disagree	Disagree
Sch2	Strongly Agree	Strongly Agree	Agree	Agree
Sch3	Agree	Strongly Agree	Strongly Agree	Strongly Agree
Sch4	Agree	Strongly Agree	Agree	Agree
Sch1	No Opinion	Disagree	Disagree	Disagree
Sch5	Strongly Disagree	Strongly Agree	Agree	Disagree
Sch11	Agree	Disagree	Disagree	Disagree
Sch14	Agree	Agree	Agree	No Opinion
Sch11	Agree	Strongly Agree	Strongly Agree	Strongly Agree
Sch4	Strongly Agree	Strongly Agree	Strongly Agree	Strongly Agree
Sch14	Strongly Agree	Strongly Agree	Strongly Agree	Agree
Sch12	Agree	Strongly Agree	Agree	Agree

Using a libname statement with the validvarname=v7 option pulls the long text questions in as shorter strings with underscores replacing spaces to meet proper formatting for processing. The varnum option in the proc contents statement provides the table which is copied and displayed in Figure 2, below the code segment:

```
libname Profrep xlsx 'F:\SAS code repository\SESUG20Z1\
teachersurveyspring2021.xlsx';
options validvarname=v7;
run;

proc contents data=tchsurtestin varnum;
run;
```

**Figure 2. Truncated Input File**

Variables in Creation Order						
#	Variable	Type	Len	Format	Informat	Label
1	school	Char	5	\$5.	\$5.	school
2	Teachers_and_staff_work_in_a_sch	Char	17	\$17.	\$17.	Teachers and staff work in a school environment that is clean and well maintained.
3	The_school_is_a_safe_environment	Char	17	\$17.	\$17.	The school is a safe environment for teachers and staff to work.
4	There_is_an_atmosphere_of_trust	Char	17	\$17.	\$17.	There is an atmosphere of trust and mutual respect.

## CONVERSIONS

The abbreviated code below is used to convert the participant responses that are loaded as text strings to a number to make composing and processing additional data steps simpler. Using a Macro shortens the code required. Macro naming conventions that hint at the intent are helpful to indicate the expected application: Char2num changes the character string to a number; varin is the incoming variable; and varout is the outcome:

```
%MACRO Char2num ;
    if &varin in ( "Strongly Disagree") then &varout = 1 ;
    else if &varin in ( "Disagree") then &varout = 2 ;
    else if &varin in ( "No Opinion") then &varout = 3 ;
    else if &varin in ( "Agree") then &varout = 4 ;
    else if &varin in ( "Strongly Agree") then &varout = 5 ;
%mend Char2num ;
```

Similar application of the varin/varout macros combined with the drop= statement to remove extraneous variables replaces the long question strings with a much simpler Q# before the text string variables are also dropped:

```
data tchsurtest (drop= entry_id entry_status created_at);
set tchsurtestin;

format Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17
Q18 Q19 Q20 Q21 Q22 Q23 Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32 Q33
2.0 ;

%let varin = Teachers_and_staff_work_in_a_sch;
%let varout = Q1 ; %Char2num;
%let varin = The_school_is_a_safe_environment;
%let varout = Q2 ; %Char2num;
%let varin = There_is_an_atmosphere_of_trust;
```

```

%let varout = Q3 ; %Char2num;
%let varin = Teachers_feel_comfortable_raisin;
%let varout = Q4 ; %Char2num;
      (Repeated through Q33)
drop
Teachers_and_staff_work_in_a_sch
The_school_is_a_safe_environment
There_is_an_atmosphere_of_trust
Teachers_feel_comfortable_raisin
      (Repeated through all 33) ;
run;

```

The simplified variables Q1 to Q33 are included in the Proc Means statement to produce a report of all questions, shown below, by the average of the numbered response:

```

proc means data=tchsurtest mean maxdec=2;
  output out=DistxAllQno;
  var Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17
      Q18 Q19 Q20 Q21 Q22 Q23 Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32 Q33;
run;

```

**Figure 3. Truncated List of All Question Means**

Variable	Mean
Q1	4.05
Q2	4.38
Q3	3.99
Q4	3.99
Q5	4.37
Q6	4.30
...	...

A dataset with each of the 33 questions by school, or work location, is obtained from the same dataset by adding the Class selection to the Proc Means statement. The code and sample *SchxQno* output for the question and location (Sch10 is displayed to show the default sort order which will be addressed later.) appears below:

```

proc means data=tchsurtest mean maxdec=2;
  Class School;
  var Q1      Q2      Q3      Q4      Q5      Q6      Q7      Q8      Q9      Q10     Q11
      Q12     Q13     Q14     Q15     Q16     Q17     Q18     Q19     Q20     Q21     Q22     Q23
      Q24     Q25     Q26     Q27     Q28     Q29     Q30     Q31     Q32     Q33;
  output out=schxQno;
run;

```

**Figure 4. Truncated List of All Question Means by Location**

school	_TYPE_	_FREQ_	_STAT_	Q1	Q2	Q3	Q4
Sch1	1	56	N	56	56	56	56
Sch1	1	56	MIN	1	1	1	1
Sch1	1	56	MAX	5	5	5	5
Sch1	1	56	MEAN	4	4	4	4
Sch1	1	56	STD	1	1	1	1
Sch10	1	39	N	39	39	39	39
Sch10	1	39	MIN	1	2	1	1
Sch10	1	39	MAX	5	5	5	5

Conversion of the complex output Proc Means procedure creates is completed in two data steps. The first employs a 'where' statement to subset the data and retain only the row in which the mean is reported for each location. In this step, the format for the mean of each question is set to display two decimal points:

```
data allbyQno ;
set schxQno ; where _STAT_ in ('MEAN') ;
format Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11
Q12 Q13 Q14 Q15 Q16 Q17 Q18 Q19 Q20 Q21 Q22 Q23
Q24 Q25 Q26 Q27 Q28 Q29 Q30 Q31 Q32 Q33 5.2;
run;
```

The second data step drops the \_TYPE\_ and \_STAT\_ variables, renames the variable \_FREQ\_ as Count, and replaces the empty row that has the means for all responses with an indicator that this is the total for the organization:

```
data allxQno;
set allbyQno;
drop _Type_ _Stat_ ;
if school = ' ' then school = 'Total' ;
Rename _Freq_ = Count ;
run;
```

The next step is to adjust the sorting sequence to prepare the output to list each location in the preferred numerical order (Sch1, Sch2, Sch3...) instead of the normal alphabetical sort (Sch1, Sch10, Sch11...). This is facilitated with the inclusion of the SORTSEQ statement:

```
proc sort data=allxQno
SORTSEQ =LINGUISTIC (NUMERIC_COLLATION=ON);
by school;
run;
```

The ODS Excel file command produces the Excel .xlsx file for distribution to the organizational leadership with the style options they prefer in the report:

```
ODS EXCEL
file='F:\SAS code repository\SESUG2021\sch and dist means.xlsx'
STYLE=Meadow OPTIONS (Orientation = 'landscape' FitToPage = 'yes'
Pages_FitWidth = '1' Pages_FitHeight= '100' row_heights="155px"
Flow='Headers' FROZEN_HEADERS='yes' gridlines='yes');
```

```
Proc print data=allxQno noobs;
run;
quit;
ods excel close;
```

**Figure 5. Truncated Output of All Means by Location and Question**

school	Count	Q1	Q2	Q3	Q4
Sch1	56	3.91	4.05	3.54	3.57
Sch2	30	3.90	3.73	2.93	2.80
Sch3	30	4.20	4.23	4.10	4.13
Sch4	125	4.42	4.56	4.35	4.49
Sch41	44	4.23	4.61	4.11	4.48
Total	2164	4.05	4.38	3.99	3.99

## TRANSFORMATIONS

An additional consideration of the level of satisfaction which the leadership reviews is the percentage of responses in the favorable 'Strongly Agree or Agree' range and also the unfavorable 'Strongly Disagree or Disagree' range by location. The cutoff of 20% is used to identify those locations with responses to each question in the highest and lowest areas of satisfaction and dissatisfaction.

Resetting the primary *tchsurtest* dataset and then proceeding through a series of data steps and statements prepares the data for a proc report that illustrates sites above and below the cutoff levels.

First, the data set is renamed and sorted:

```
data tchsurtestSAS ;
set tchsurtest;
run;

proc sort data=tchsurtestSAS;
by school;
run;
```

Second, a new variable is created which will number responses by the variable *school* as designated in the Proc Transpose statement:

```
data tchsurtestSASn;
set tchsurtestSAS;
    n = _n_;
run;

proc transpose
data=tchsurtestSASn
    out=long (drop=n rename=(_name_=question));
    by n school;
    var q;;
run;
```

This provides an output dataset, *long*, which has every response for every question in a table of 71412 rows, as the product of 33 questions from 2,164 responses. This is displayed in the first column of Figure 6 below.

Third, a new format is introduced that will allow the currently numbered question responses to be sorted and counted by a character value. The selection of D, O, A, and N represent the responses that include Strongly/Disagree, No Opinion, Strongly/Agree, and no response, respectively. The N is later excluded from the step that calculates the percentages for each favorable or unfavorable response:

```
proc format;
    value ans.
        1,2 = 'D'
        3 = 'O'
        4,5 = 'A'
        . = 'N';
run;
```

Then the new format is applied to the long *long* data set as it is reset as *long2* and replaces the numbers with the character value in the previously established ans. format:

```

data long2;
set long;
answer = put(coll,ans.);
drop coll;
run;

```

**Figure 6. Truncated Output of Responses with Count and Count Reformatted as Characters**

	school	question	COL1
1	Sch1	Q1	2
2	Sch1	Q2	4
3	Sch1	Q3	4
4	Sch1	Q4	4
71410	Sch9	Q31	5
71411	Sch9	Q32	3
71412	Sch9	Q33	3

	school	question	answer
1	Sch1	Q1	D
2	Sch1	Q2	A
3	Sch1	Q3	A
4	Sch1	Q4	A
71410	Sch9	Q31	A
71411	Sch9	Q32	O
71412	Sch9	Q33	O

The long2 dataset is subset by eliminating blank responses so they won't affect the count of responses in calculating the percentages. Applying the summary statement, dropping unnecessary variables, using formulas to create the count and percent, and processing each question by school assigns the percentage to each of the questions by the character value:

```

proc summary data=long2 nway;
  Where answer ne 'N';
  class school question answer;
  output out=sum
  (drop=_type_);
run;

data sum_long;
  do until (last.question);
set sum;
  by school question;
  count = sum(count,_freq_);
end;
format percent percent7.2;
  do until (last.question);
set sum;
  by school question;
  percent = _freq_ / count;
  output;
end;
keep school question answer percent;
run;

```

**Figure 7. Truncated Output of Dataset with Percentages**

school	question	answer	percent
Sch1	Q1	A	82.1%
Sch1	Q1	D	16.1%
Sch1	Q1	O	1.79%
Sch1	Q10	A	46.4%
Sch1	Q10	D	37.5%
Sch1	Q10	O	16.1%

Finally, the information is rearranged and sorted by school to create the full dataset want, with all questions identified by a combined question number and character variable in preparation for the Proc Report step

```
proc transpose data=sum_long out=want (drop=_name_);
  by school;
  var percent;
  id question answer;
run;

proc sort data=want;
  by school;
run;
```

## PROC REPORT

A macro is created to make it easy to change components of the Proc Report for the separate units or composite results and to allow for quick adjustments. The macro sets the parameters of the *Proc Report* so it can be invoked for all responses or for each unit separately.

The listing of columns in the order they are to be displayed appears first, then the *Define* statements which alter the column header label and the column width as appropriate. A snip of these code segments are below:

\*\*\*Creating the Macro\*\*\*

```
%MACRO survey45;
column School Q1A Q2A Q3A Q4A Q5A Q6A Q7A Q8A Q9A Q10A Q11A Q12A Q13A
Q14A Q15A Q16A Q17A Q18A Q19A Q20A Q21A Q22A Q23A Q24A Q25A Q26A Q27A
Q28A Q29A Q30A Q31A Q32A Q33A;

define school /display "School" style(column)={width=240};
Define Q1A /display "Q1A 4 or 5" Format = percent7.1;
  (Repeated through all 33)
```

To simplify interpretation, color-coding the targeted favorable levels of the question responses allows for a quick visual reading of the areas for individual or groups of locations. The colors are added by applying compute statement in the *Proc Report*. The same color scheme is applied to the 33 questions with favorable responses at a rounded 80%:

```
Compute Q1A;;
  if Q1A ge 0.795 then call define
  (_col_, "style", "style={background=skyblue}");
endcomp;
  (Repeated through all 33)
```

```
run
%mend survey45 ;
```

The inverse, unfavorable responses, is obtained through a similar macro which changes the compute statement cutoff level and color:

```
%MACRO survey12
column School Q1D Q2D Q3D Q4D Q5D Q6D Q7D Q8D Q9D Q10D Q11D Q12D Q13D
Q14D Q15D Q16D Q17D Q18D Q19D Q20D Q21D Q22D Q23D Q24D Q25D Q26D Q27D
Q28D Q29D Q30D Q31D Q32D Q33D;

Define School/display "School" ;
Define Q1D /display "Q1D 1 or2" Format = percent7.1 ;
      (Repeated through all 33)

Compute Q1D;; if Q1D ge 0.194 then call
define(_col_,"style","style={background=yellow}") ;endcomp;
      (Repeated through all 33)
```

**Figure 7. Truncated Output of Favorable/Unfavorable with Percentages Highlighted**

School	Q1A 4 or 5	Q2A 4 or 5	Q3A 4 or 5	Q4A 4 or 5	School	Q1D 1 or2	Q2D 1 or2	Q3D 1 or2	Q4D 1 or2
Sch1	82.1%	87.5%	62.5%	62.5%	Sch1	16.1%	10.7%	26.8%	16.1%
Sch2	80.0%	73.3%	46.7%	43.3%	Sch2	10.0%	16.7%	46.7%	46.7%
Sch3	96.7%	93.3%	80.0%	90.0%	Sch3	3.3%	6.7%	6.7%	6.7%
Sch4	91.2%	93.6%	88.8%	91.2%	Sch4	3.2%	0.8%	5.6%	3.2%
Sch5	66.7%	92.8%	82.6%	84.1%	Sch5	21.7%	1.4%	10.1%	10.1%
Sch6	83.9%	100.0%	87.1%	90.3%	Sch6	9.7%	.	6.5%	6.5%

As mentioned above, macros can be directed to produce similar outputs for different input datasets. The complication in this instance is that the calculation of the blank responses for the organization by question is not the same as for the individual units, since they are combined for the organization. Simply adding an identifier to the data set throughout the transformation data steps and the macro allows a simple adjustment to the Proc Format column and define statements to produce a report with selective variants:

```
data tchsurDIST ;
set tchsurtest;
  Format Dist 2.0;
  Dist = 56;
  Drop School;
  n = _n_;
run;

proc transpose
data=tchsurDIST
out=longD (drop=n rename=( _name_=question));
by n;
```

```

var q;;
run;

proc format;
value ans.
  1,2 = 'D'
  3 = 'O'
  4,5 = 'A'
  . = 'N'
;
run;

data long2D;
set longD ...

```

After the `"survey45"`, `"survey12"`, `"survey45D"`, and `"survey12d"` macros are created, they invoked in the appropriate *Proc Report* step in the ODS segment:

```

ODS EXCEL
file='F:\SAS code repository\SESUG 21\Dist Disagree_fromSAS.xlsx'
  STYLE=Meadow OPTIONS (Orientation = 'landscape' FitToPage = 'yes'
  Pages_FitWidth = '1' Pages_FitHeight= '100' row_heights="155px"
  Flow='Headers' FROZEN_HEADERS='yes' gridlines='yes');

Proc Report
data=wantD nowd;
%survey12d;
run;
quit;
ods excel close;

```

## PROC SGPANEL

Producing all in one graphical reports for each individual unit provides the managers of those locations with a quick visual to determine areas which might need immediate attention because of a preponderance of 'Strongly Disagree' responses in one or more areas. This does require going back to the earlier adjusted database and going through the transformation steps above with minor changes to the database names in the data steps to avoid loading older databases in the work library into the processes. Only the earliest code segments of the transformation steps are shown below:

```

data schquest;
set tchsurtest;
run;

proc sort data=schquest;
  by school;
run;

data schquestn;
set schquest;
  n = _n_;
run;

proc transpose
data=schquestn
  out=longS (drop=n rename=(name=question));

```

```

        by n school;
        var q;;
run;

```

Rather than using the ans. format form the percentage calculations, the answ. format restores the original survey response selection as a text string in place of the number value:

```

proc format;
    value answ.
        1 = 'Strongly_Disagree'
        2 = 'Disagree'
        3 = 'No_Opinion'= 'Agree'
        5 = 'Strongly_Agree'
        . = 'N';
run;

```

```

data longq;
set longS;
    answer = put(coll,answ.);
    drop coll;
run;

```

(Proc Summary, Set, and Proc Transpose statements not shown)

```

data ansxsch;
set sum_longQ;
    response = cats(Question,': ',Answer);
    rename _freq_=count;
    Format Text $225.;
    Text = ' ';
    if question =: 'Q1' then text = 'Teachers and staff work in a
    school environment that is clean and well maintained.';
    (Repeated through all 33)

```

In small units, one negative response could represent a large slice of the percentage for a question, but the percentage is an important value in all cases. In order to show both the count and percentage of responses in the data labels it is necessary to concatenate them into a new variable. The SORTSEQ option is again invoked to order the sequence by numbered question:

```

data ansxschplot;
set ansxsch;
    pctcount =
        trim(left(Count))||' or '||trim(left(put(percent,percent7.2)));
    keep school question answer percent text pctcount;
run;

proc sort data=ansxschplot
    SORTSEQ =LINGUISTIC (NUMERIC_COLLATION=ON);
    by question;
run;

```

The process below is repeated by each unit, by using a macro or repeated code to change the input variable in the title, filename and where statements:

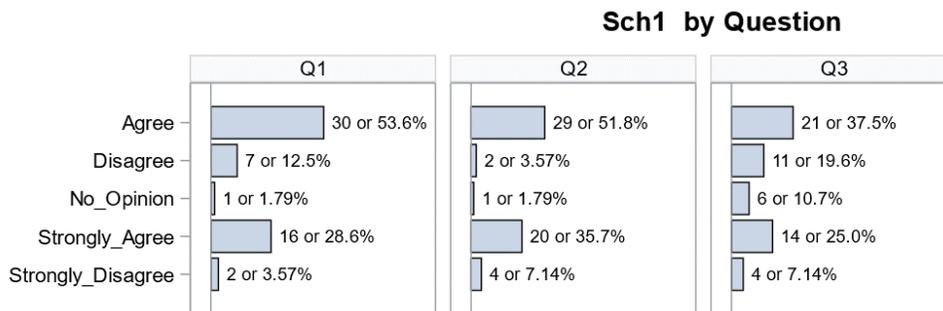
```

title1;
title'Sch1 by Question';
options papersize=("17in","11in"); run;

```

```
ods excel file=
'F:\SAS code repository\SESUG2021\Sch1 Allbarsin1.xlsx';
ods excel options(autofilter="1-5" sheet_name = "All Questions by
School") embedded_titles='yes' sheet_interval = 'none');
run;
ods graphics on / width = 12in;
proc sgpanel data = ansxschplot
(where=(School='Sch1'));
panelby question/rows = 7 columns = 5 novarname spacing = 4
nowall skipemptycells;
hbar answer / response=percent datalabel=pctcount
datalabelattrs=(size=8pt);
run;
ods excel close;
run;
quit;
title;
```

**Figure 8. Truncated Output Excel All in One Graph File**



## RESULTS

As illustrated in Figures 1-9, results for every organizational level and every question can allow pinpoint attention to areas of major and substantial concern. Units can be grouped together in any combination to reflect mid-level supervisory performance.

The full question mean file, in Figure 5 above and below can show a potential issue by unit if viewed horizontally, as Sch2 is below 3 for 2 questions. Viewing the table vertically, it appears that those two questions may need to be examined throughout the organization.

**Figure 9. Repeat of Figure 5: Truncated Output of All Means by Location and Question**

school	Count	Q1	Q2	Q3	Q4
Sch1	56	3.91	4.05	3.54	3.57
Sch2	30	3.90	3.73	2.93	2.80
Sch3	30	4.20	4.23	4.10	4.13
Sch4	125	4.42	4.56	4.35	4.49
Sch41	44	4.23	4.61	4.11	4.48
Total	2164	4.05	4.38	3.99	3.99

Providing this level of detail two or more times a year allows for rapid response and corrective action while using consistent measurements. Positive and negative trends in averages and percentages can identify a problem area before it becomes a crisis.

## CONCLUSION

The process provides organization and unit leaders valuable information about their locations and employees and the levels of satisfaction relative to other units and organizational results. Any degree of error in the initial data or interpretation of the questions will always produce some inconsistencies. While data can reflect trends and areas for further analysis, the final determination on how to react to the report is a key leadership issue.

## REFERENCES

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## CONTACT INFORMATION

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