



Marzano High Reliability Schools™

A Summary of Administrator and Staff Perceptions Regarding Leading Indicators for Level 1

Prepared by Marzano Resources

for

Manvel Public School

Manvel, North Dakota

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**Our
Vision**

Transform education worldwide
to ensure learning for all.

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REPORT AUTHOR

Mark W. Haystead

MARZANO RESOURCES – BLOOMINGTON, IN

Business Office
555 N. Morton Street
Bloomington, IN 47404
Phone: 888-849-0851
Fax: 866-801-1447

MARZANO RESOURCES – CENTENNIAL, CO

Marzano Resources Training Center
12577 E. Caley Avenue
Centennial, CO 80111
Phone: 303-766-9199
Fax: 303-694-1778

www.MarzanoResources.com

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Introduction

Administrative staff, teachers, and other stakeholders at Manvel Public School responded to an online survey designed to gauge their school's status on the first level of the Marzano High Reliability Schools™ (HRS) framework. Level 1 has eight leading indicators that address factors considered foundational to developing and maintaining a safe, supportive, and collaborative school culture:

Leading Indicator 1.1: The faculty and staff perceive the school environment as safe and orderly.

Leading Indicator 1.2: Students, parents, and the community perceive the school environment as safe and orderly.

Leading Indicator 1.3: Teachers have formal roles in the decision-making process regarding school initiatives.

Leading Indicator 1.4: Teacher teams and collaborative groups meet regularly to interact and address common issues regarding curriculum, assessment, instruction, and the achievement of all students.

Leading Indicator 1.5: Teachers and staff have formal ways to provide input regarding the optimal functioning of the school.

Leading Indicator 1.6: Students, parents, and the community have formal ways to provide input regarding optimal functioning of our school.

Leading Indicator 1.7: The success of the whole school, as well as individuals within the school, is appropriately acknowledged.

Leading Indicator 1.8: The fiscal, operational, and technological resources of the school are managed in a way that directly supports teachers.

These leading indicators were designed to help school leaders determine what is already working well and identify areas in need of focused attention. (For a more thorough discussion of HRS, see Marzano, Warrick, & Simms, 2014.)

School stakeholders anonymously rated their level of agreement with statements related to each leading indicator. Each statement had five response choices ordered from greatest disagreement to greatest agreement (numeric values noted in parentheses): strongly disagree (1), disagree (2), neither disagree nor agree (3), agree (4), and strongly agree (5). Stakeholders were allowed to respond to any statement with a rating of *n/a* or *don't know*.

To provide an aggregate summary of respondents’ ratings of agreement, three descriptive statistics were calculated from the numeric values: (1) mean, (2) mode, and (3) standard deviation. The mean is the arithmetic average of the numeric values of the respondents’ ratings, the mode is the most common value(s) selected by respondents, and standard deviation is a measure of the amount of variation among the numeric values. (For a more detailed discussion, see Technical Note.) It should be noted that ratings of *n/a or don’t know* were treated as missing and excluded from the descriptive statistics.

Data Analysis and Findings

Table 1 displays the number of surveys that were completed by administrators, teachers, and other staff members at Manvel Public School.

Table 1: Completed Survey Counts

	Completed Survey Counts
Administrator	2
Teacher/Staff	32

Again, school stakeholders responded to survey items using a 5-point agreement scale. It should be noted that, in addition to calculating means from the numeric values of respondents’ ratings for each item, overall means were calculated from the item means for each leading indicator. Descriptive statistics for each leading indicator are presented separately. As noted earlier, ratings of *n/a or don’t know* were excluded from the descriptive statistics. Additional consideration might be warranted for any survey item with a lower than anticipated response count.

Means greater than 3.5 suggest a majority of respondents agreed with a survey item. Means less than 2.5 suggest a majority of respondents disagreed. Means close to 3.0 suggest: (1) similar numbers of respondents who agreed and disagreed and/or (2) more respondents who neither disagreed nor agreed.

Leading Indicator 1.1: The faculty and staff perceive the school environment as safe and orderly.

Tables 2 and 3 list the descriptive statistics for leading indicator 1.1.

Table 2: Descriptive Statistics for Leading Indicator 1.1 (Administrator)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Our school is a safe place.	4.00	0.00	4	2
Our school is an orderly place.	4.00	0.00	4	2
Our school has clear and specific rules and procedures in place.	4.00	0.00	4	2
Teachers and staff know the emergency management procedures for our school.	4.50	0.71	4,5	2
Teachers and staff know how to implement the emergency management procedures for our school.	4.00	0.00	4	2
Teachers, staff, and students regularly practice implementing emergency management procedures for specific incidents.	4.00	1.41	3,5	2
Our school's emergency management procedures are updated on a regular basis.	3.00	0.00	3	2

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 2 indicates that administrators' mean item responses for leading indicator 1.1 ranged from 3.00 to 4.50. The overall mean (with standard deviation in parentheses) was 3.93 (0.45).

Table 3: Descriptive Statistics for Leading Indicator 1.1 (Teacher/Staff)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Our school is a safe place.	4.72	0.46	5	32
Our school is an orderly place.	4.47	0.51	4	32
Our school has clear and specific rules and procedures in place.	4.50	0.62	5	32
I know the emergency management procedures for our school.	4.19	0.47	4	32
I know how to implement the emergency management procedures for our school.	4.16	0.72	4	32
My students and I practice implementing emergency management procedures for specific incidents.	4.27	0.64	4	30
Our school's emergency management procedures are updated on a regular basis.	4.42	0.50	4	31

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 3 indicates that teachers' and staff members' mean item responses for leading indicator 1.1 ranged from 4.16 to 4.72. The overall mean was 4.39 (0.20).

Leading Indicator 1.2: Students, parents, and the community perceive the school environment as safe and orderly.

Tables 4 and 5 list the descriptive statistics for leading indicator 1.2.

Table 4: Descriptive Statistics for Leading Indicator 1.2 (Administrator)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Students and their parents describe our school as a safe place.	4.00	0.00	4	2
Students and their parents describe our school as an orderly place.	4.00	0.00	4	2
Students and their parents are aware of the rules and procedures in place at our school.	4.00	0.00	4	2
Our school uses social media to allow anonymous reporting of potential incidents.	2.50	0.71	2,3	2
Our school has a system that allows me to communicate with parents about issues regarding school safety (for example, a school call-out system).	4.50	0.71	4,5	2
I coordinate with local law enforcement agencies regarding school safety issues.	4.50	0.71	4,5	2
I engage parents and the community regarding school safety issues.	4.00	0.00	4	2

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 4 indicates that administrators' mean item responses for leading indicator 1.2 ranged from 2.50 to 4.50. The overall mean was 3.93 (0.67).

Table 5: Descriptive Statistics for Leading Indicator 1.2 (Teacher/Staff)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Students and their parents describe our school as a safe place.	4.55	0.51	5	31
Students and their parents describe our school as an orderly place.	4.39	0.56	4	31
Students and their parents are aware of the rules and procedures in place at our school.	4.16	0.45	4	31
Our school uses social media to allow anonymous reporting of potential incidents.	3.90	1.00	4,5	21
Our school has a system that allows school leaders to communicate with parents about issues regarding school safety (for example, a school call-out system).	4.71	0.46	5	31
School leaders coordinate with local law enforcement agencies regarding school safety issues.	4.59	0.50	5	32
School leaders engage parents and the community regarding school safety issues.	4.50	0.57	5	32

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 5 indicates that teachers' and staff members' mean item responses for leading indicator 1.2 ranged from 3.90 to 4.71. The overall mean was 4.40 (0.28).

Leading Indicator 1.3: Teachers have formal roles in the decision-making process regarding school initiatives.

Tables 6 and 7 list the descriptive statistics for leading indicator 1.3.

Table 6: Descriptive Statistics for Leading Indicator 1.3 (Administrator)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
It is clear which types of decisions will be made with direct teacher input.	3.50	0.71	3,4	2
Techniques and systems are in place to collect data and information from teachers on a regular basis.	4.00	0.00	4	2
Notes and reports exist documenting how teacher input was used to make specific decisions.	3.50	0.71	3,4	2
Electronic tools (for example, online survey tools) are used to collect teachers' opinions regarding specific decisions.	4.50	0.71	4,5	2
Groups of teachers are targeted to provide input regarding specific decisions.	4.50	0.71	4,5	2

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 6 indicates that administrators' mean item responses for leading indicator 1.3 ranged from 3.50 to 4.50. The overall mean was 4.00 (0.50).

Table 7: Descriptive Statistics for Leading Indicator 1.3 (Teacher/Staff)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
It is clear which types of decisions will be made with direct teacher input.	3.97	0.63	4	29
Techniques and systems are in place to collect data and information from teachers on a regular basis.	4.27	0.58	4	30
Notes and reports exist documenting how teacher input was used to make specific decisions.	3.88	0.77	4	26
Electronic tools (for example, online survey tools) are used to collect teachers' opinions regarding specific decisions.	4.42	0.56	4	31
Groups of teachers are targeted to provide input regarding specific decisions.	4.23	0.56	4	31

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 7 indicates that teachers' and staff members' mean item responses for leading indicator 1.3 ranged from 3.88 to 4.42. The overall mean was 4.15 (0.22).

Leading Indicator 1.4: Teacher teams and collaborative groups regularly interact to address common issues regarding curriculum, assessment, instruction, and the achievement of all students.

Tables 8 and 9 list the descriptive statistics for leading indicator 1.4.

Table 8: Descriptive Statistics for Leading Indicator 1.4 (Administrator)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
A professional learning community (PLC) process is in place in our school.	4.50	0.71	4,5	2
Our school's PLC collaborative teams have written goals.	4.00	1.41	3,5	2
I regularly examine PLC collaborative teams' progress toward their goals.	3.00	1.41	2,4	2
Our school's PLC collaborative teams create common assessments.	2.50	0.71	2,3	2
Our school's PLC collaborative teams analyze student achievement and growth.	4.00	0.00	4	2
Data teams are in place in our school.	4.00	0.00	4	2
Our school's data teams have written goals.	3.00	0.00	3	2
I regularly examine data teams' progress toward their goals.	3.50	0.71	3,4	2
I collect and review minutes and notes from PLC collaborative team and data team meetings to ensure that teams are focusing on student achievement.	4.50	0.71	4,5	2

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 8 indicates that administrators' mean item responses for leading indicator 1.4 ranged from 2.50 to 4.50. The overall mean was 3.67 (0.71).

Table 9: Descriptive Statistics for Leading Indicator 1.4 (Teacher/Staff)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
A professional learning community (PLC) process is in place in our school.	4.68	0.48	5	31
Our school's PLC collaborative teams have written goals.	4.38	0.55	4	32
School leaders regularly examine PLC collaborative teams' progress toward their goals.	4.24	0.64	4	29
Our school's PLC collaborative teams create common assessments.	3.84	0.80	4	25
Our school's PLC collaborative teams analyze student achievement and growth.	4.40	0.56	4	30
Data teams are in place in our school.	4.00	0.73	4	27
Our school's data teams have written goals.	3.92	0.80	4	26
School leaders regularly examine data teams' progress toward their goals.	3.96	0.84	4	28
School leaders collect and review minutes and notes from PLC collaborative team and data team meetings to ensure that teams are focusing on student achievement.	4.42	0.70	5	26

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 9 indicates that teachers' and staff members' mean item responses for leading indicator 1.4 ranged from 3.84 to 4.68. The overall mean was 4.20 (0.29).

Leading Indicator 1.5: Teachers and staff have formal ways to provide input regarding the optimal functioning of the school.

Tables 10 and 11 list the descriptive statistics for leading indicator 1.5.

Table 10: Descriptive Statistics for Leading Indicator 1.5 (Administrator)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Data collection systems are in place to collect opinion data from teachers and staff regarding the optimal functioning of our school.	4.50	0.71	4,5	2
Opinion data collected from teachers and staff are archived.	3.50	0.71	3,4	2
Reports of opinion data from teachers and staff are regularly generated.	3.50	0.71	3,4	2
The manner in which opinion data from teachers and staff are used is transparent.	3.50	0.71	3,4	2
Our school improvement team regularly provides input and feedback about our school's improvement plan.	4.50	0.71	4,5	2

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 10 indicates that administrators' mean item responses for leading indicator 1.5 ranged from 3.50 to 4.50. The overall mean was 3.90 (0.55).

Table 11: Descriptive Statistics for Leading Indicator 1.5 (Teacher/Staff)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Data collection systems are in place to collect opinion data from teachers and staff regarding the optimal functioning of our school.	4.11	0.42	4	27
Opinion data collected from teachers and staffs are archived.	3.80	0.70	4	20
Reports of opinion data from teachers and staff are regularly generated.	3.85	0.67	4	20
The manner in which opinion data from teachers and staff are used is transparent.	3.70	0.80	4	20
Our school improvement team regularly provides input and feedback about our school's improvement plan.	4.19	0.75	4	31

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 11 indicates that teachers' and staff members' mean item responses for leading indicator 1.5 ranged from 3.70 to 4.19. The overall mean was 3.93 (0.21).

Leading Indicator 1.6: Students, parents, and the community have formal ways to provide input regarding the optimal functioning of the school.

Tables 12 and 13 list the descriptive statistics for leading indicator 1.6.

Table 12: Descriptive Statistics for Leading Indicator 1.6 (Administrator)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Data collection systems are in place to collect opinion data from students, parents, and the community regarding the optimal functioning of our school.	3.50	0.71	3,4	2
Opinion data collected from students, parents, and the community are archived.	4.00	0.00	4	2
Reports of opinion data from students, parents, and the community are regularly generated.	3.50	0.71	3,4	2
The manner in which opinion data from students, parents, and the community are used is transparent.	3.50	0.71	3,4	2
Our school hosts an interactive website for students, parents, and the community.	4.00	0.00	4	2
I use social networking technologies (such as Twitter and Facebook) to involve students, parents, and the community.	5.00	0.00	5	2
I host virtual town hall meetings.	2.50	0.71	2,3	2
I conduct focus group meetings with students, parents, and the community.	3.50	0.71	3,4	2
I host or speak at community/business luncheons.	3.50	0.71	3,4	2

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 12 indicates that administrators' mean item responses for leading indicator 1.6 ranged from 2.50 to 5.00. The overall mean was 3.67 (0.66).

Table 13: Descriptive Statistics for Leading Indicator 1.6 (Teacher/Staff)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Data collection systems are in place to collect opinion data from students, parents, and the community regarding the optimal functioning of our school.	4.04	0.72	4	26
Opinion data collected from students, parents, and the community are archived.	3.89	0.76	4	18
Reports of opinion data from students, parents, and the community are regularly generated.	3.89	0.83	4	18
The manner in which opinion data from students, parents, and the community are used is transparent.	3.64	0.85	4	22
Our school hosts an interactive website for students, parents, and the community.	4.59	0.50	5	32
I use social networking technologies (such as Twitter and Facebook) to involve students, parents, and the community.	4.14	1.30	5	29
School leaders host virtual town hall meetings.	3.33	1.11	2,3	21
School leaders conduct focus group meetings with students, parents, and the community.	3.74	0.94	4	27
School leaders host or speak at community/business luncheons.	3.35	1.11	4	23

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 13 indicates that teachers' and staff members' mean item responses for leading indicator 1.6 ranged from 3.33 to 4.59. The overall mean was 3.85 (0.40).

Leading Indicator 1.7: The success of the whole school, as well as individuals within the school, is appropriately acknowledged.

Tables 14 and 15 list the descriptive statistics for leading indicator 1.7.

Table 14: Descriptive Statistics for Leading Indicator 1.7 (Administrator)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Our school's accomplishments have been adequately acknowledged and celebrated.	5.00	0.00	5	2
Teacher teams' or departments' accomplishments have been adequately acknowledged and celebrated.	4.50	0.71	4,5	2
Individual teachers' accomplishments have been adequately acknowledged and celebrated.	4.50	0.71	4,5	2
I acknowledge and celebrate individual accomplishments, teacher-team or department accomplishments, and whole-school accomplishments in a variety of ways (for example, through faculty celebrations, newsletters to parents, announcements; the school website, or social media).	4.50	0.71	4,5	2
I regularly celebrate the successes of individuals in a variety of positions in the school (such as teachers or support staff).	4.50	0.71	4,5	2

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 14 indicates that administrators' mean item responses for leading indicator 1.7 ranged from 4.50 to 5.00. The overall mean was 4.60 (0.22).

Table 15: Descriptive Statistics for Leading Indicator 1.7 (Teacher/Staff)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Our school's accomplishments have been adequately acknowledged and celebrated.	4.53	0.51	5	32
My team's or department's accomplishments have been adequately acknowledged and celebrated.	4.26	0.68	4	31
My individual accomplishments have been adequately acknowledged and celebrated.	4.28	0.81	4	32
School leaders acknowledge and celebrate individual accomplishments, teacher-team or department accomplishments, and whole-school accomplishments in a variety of ways (for example, through faculty celebrations, newsletters to parents, announcements; the school website; or social media).	4.52	0.51	5	31
School leaders regularly celebrate the successes of individuals in a variety of positions in the school (such as teachers or support staff).	4.50	0.51	4,5	32

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 15 indicates that teachers' and staff members' mean item responses for leading indicator 1.7 ranged from 4.26 to 4.53. The overall mean was 4.42 (0.14).

Leading Indicator 1.8: The fiscal, operational, and technological resources of the school are managed in a way that directly supports teachers.

Tables 16 and 17 list the descriptive statistics for leading indicator 1.8.

Table 16: Descriptive Statistics for Leading Indicator 1.8 (Administrator)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
Teachers have adequate materials to teach effectively.	4.50	0.71	4,5	2
Teachers have adequate time to teach effectively.	4.00	0.00	4	2
I develop, submit, and implement detailed budgets.	3.50	0.71	3,4	2
I successfully access and leverage a variety of fiscal resources (such as grants or title funds).	3.50	0.71	3,4	2
I manage time to maximize a focus on instruction.	3.50	0.71	3,4	2
I direct the use of technology to improve teaching and learning.	3.50	0.71	3,4	2
I provide adequate training for the instructional technology teachers are expected to use.	3.50	0.71	3,4	2

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 16 indicates that administrators' mean item responses for leading indicator 1.8 ranged from 3.50 to 4.50. The overall mean was 3.71 (0.39).

Table 17: Descriptive Statistics for Leading Indicator 1.8 (Teacher/Staff)

Survey Item	<i>M</i>	<i>SD</i>	<i>Mode</i>	<i>n</i>
I have adequate materials to teach effectively.	4.07	0.73	4	27
I have adequate time to teach effectively.	3.93	0.78	4	27
School leaders develop, submit, and implement detailed budgets.	4.27	0.60	4	26
School leaders successfully access and leverage a variety of fiscal resources (such as grants or title funds).	4.37	0.56	4	27
School leaders manage time to maximize a focus on instruction.	4.13	0.63	4	30
School leaders direct the use of technology to improve teaching and learning.	4.23	0.56	4	31
School leaders provide adequate training for the instructional technology teachers are expected to use.	3.93	0.84	4	29

Note. *M* = arithmetic mean; *SD* = standard deviation; *Mode* = most common response(s); *n* = valid response count.

Table 17 indicates that teachers' and staff members' mean item responses for leading indicator 1.8 ranged from 3.93 to 4.37. The overall mean was 4.13 (0.17).

Summary and Discussion

Administrative staff, teachers, and other stakeholders at Manvel Public School responded to an online survey designed to gauge their school’s status on the first level of the Marzano High Reliability Schools™ (HRS) framework. The survey had five response choices ordered from greatest disagreement to greatest agreement (numeric values noted in parentheses): strongly disagree (1), disagree (2), neither disagree nor agree (3), agree (4), and strongly agree (5). In addition, stakeholders had the option to respond with a rating of *n/a* or *don’t know*.

Table 18 summarizes the overall means for each leading indicator.

Table 18: Overall Means for Level 1 Leading Indicators

Leading Indicator	Administrator		Teacher/Staff	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
1.1: The faculty and staff perceive the school environment as safe and orderly.	3.93	0.45	4.39	0.20
1.2: Students, parents, and the community perceive the school environment as safe and orderly.	3.93	0.67	4.40	0.28
1.3: Teachers have formal roles in the decision-making process regarding school initiatives.	4.00	0.50	4.15	0.22
1.4: Teacher teams and collaborative groups regularly interact to address common issues regarding curriculum, assessment, instruction, and the achievement of all students.	3.67	0.71	4.20	0.29
1.5: Teachers and staff have formal ways to provide input regarding the optimal functioning of the school.	3.90	0.55	3.93	0.21
1.6: Students, parents, and the community have formal ways to provide input regarding the optimal functioning of the school.	3.67	0.66	3.85	0.40
1.7: The success of the whole school, as well as individuals within the school, is appropriately acknowledged.	4.60	0.22	4.42	0.14
1.8: The fiscal, operational, and technological resources of the school are managed in a way that directly supports teachers.	3.71	0.39	4.13	0.17

Note. *M* = arithmetic mean; *SD* = standard deviation. Overall means and standard deviations were calculated from item means. The standard deviations reflect the amount of variation among the reported means for each leading indicator.

Table 18 indicates that administrators' overall means ranged from 3.67 to 4.60. Teachers' and staff members' overall means ranged from 3.85 to 4.42.

Again, survey-item means greater than 3.5 suggest a majority of respondents agreed. Means less than 2.5 suggest a majority of respondents disagreed. Means close to 3.0 suggest: (1) similar numbers of respondents who agreed and disagreed and/or (2) more respondents who neither disagreed nor agreed. Also, ratings of *n/a* or *don’t know* were excluded from the descriptive statistics. Therefore, survey items with lower than anticipated response counts might warrant further consideration. Finally, overall means

greater than 3.5 suggest respondents agreed with a majority of the leading indicator survey items, further suggesting the school might be doing well in those areas. Conversely, overall means less than 2.5 suggest respondents disagreed with a majority of the leading indicator survey items, further suggesting those areas might need focused attention.

Technical Note

In social science research, three statistical measures can be used to describe data sets considered in an analysis: (1) mean, (2) mode, and (3) standard deviation.

To calculate the mean, the sum of scores in a data set is divided by the total number of scores in the set:

$$M = \frac{X_1 + X_2 + \cdots + X_n}{n}$$

As a measure of central tendency, the mean is used to describe the center of a distribution of scores while taking into account every score in the distribution. However, it is important to note that outliers (that is, scores that are very different from most of the distribution) can have a substantial influence on the mean. Consider the following ordered set of numbers: {5, 6, 7, 8, 9, 20}. Although four numbers are less than 9 and one number is greater than 9, the mean suggests that the center of the distribution is slightly higher than 9, $M = 9.17$.

The mode of a data set is the score that appears most frequently. However, it is worth noting that more than one score might appear with the same frequency. In other words, a data set can have more than one mode. A set with two modes is bi-modal, a set with three modes is tri-modal, a set with four modes is quad-modal, and so on. Consider the following ordered set of numbers: {4, 5, 5, 7, 8, 8, 8, 9, 11, 14, 14, 14, 15, 19, 19}. The numbers 4, 7, 9, 11, and 15 occur once; the numbers 5 and 19 occur twice; and the numbers 8 and 14 occur three times. The data set is bi-modal and the modes are 8 and 14.

Standard deviation is related to the variance of a data set. The variance of a data set reflects the amount of error between the mean and the scores in the set ($X_i - M$). Stated differently, the variance provides a measure of the extent to which each score differs from the mean. However, it is important to note that individual errors can be positive or negative depending on whether a score is higher or lower than the mean. Positive and negative errors of the same magnitude (for example, ± 4) would cancel each other out when summed as a measure of total error. Therefore, the sum of squared errors is used to calculate the sample variance instead of the mean of the individual errors:

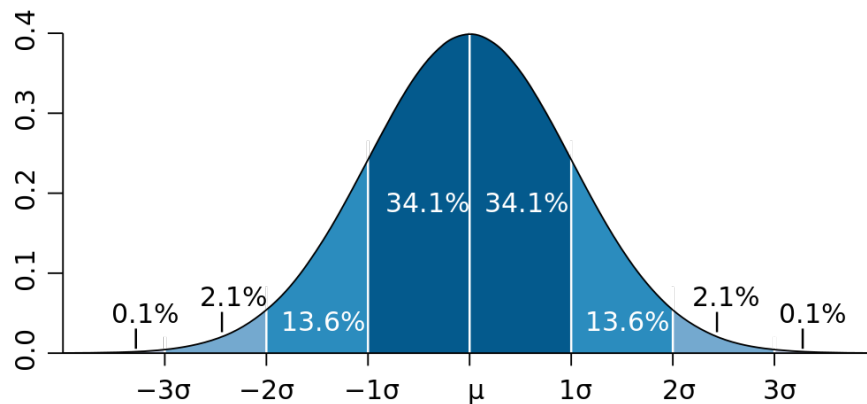
$$s^2 = \frac{(X_1 - M)^2 + (X_2 - M)^2 + \cdots + (X_n - M)^2}{n - 1}$$

The sample standard deviation is the square root of the sample variance:

$$s = \sqrt{\frac{(X_1 - M)^2 + (X_2 - M)^2 + \dots + (X_n - M)^2}{n - 1}}$$

By taking the square root, the average error is expressed in the same units as the original scores in the data set instead of units squared. Standard deviation is used to describe how far the scores are spread out from each other. Generally speaking, the higher the standard deviation, the greater the variation among scores.

When using the mean and standard deviation to describe data sets, it is important to consider the distribution of scores within each set. One widely recognized distribution is the normal distribution (commonly referred to as the bell curve). As Figure TN1 illustrates, a normal distribution is symmetrical with about 68% of the data points lying within one standard deviation of the mean (Lane, n.d.).



Source: Mwtoews, 2007. μ = mean; σ = standard deviation. Image is licensed under the Creative Commons Attribution 2.5 Generic license. <http://creativecommons.org/licenses/by/2.5/deed.en>

Figure TN1: The normal distribution.

Consider a hypothetical data set of 100 numbers from a normal distribution with a mean of 50 and standard deviation of 15. Approximately 68% of the numbers would be one standard deviation from the mean (that is, 50 ± 15) and 95% of the numbers would be two standard deviations from the mean (that is, 50 ± 30). In other words, approximately 14% of the numbers would be between 20 and 35, 34% would be between 35 and 50, 34% would be between 50 and 65, and 14% would be between 65 and 80. Approximately 2% of the numbers would be less than 20 and 2% of the numbers would be greater than 80.

Consider also a 5-point agreement scale: strongly disagree (1), disagree (2), neither disagree nor agree (3), agree (4), and strongly agree (5). If respondents' ratings to a survey item were normally distributed with a mean of 3.0 and standard deviation of 0.5, then approximately 68% of the responses would range from 2.5 to 3.5 (3.0 ± 0.5), 14% would range from 2.0 to 2.5, and 14% would range from 3.5 to 4.0.

Given that the agreement scale contains whole numbers, the mean and standard deviation might suggest the following pattern of responses: approximately 68% of the respondents neither disagreed nor agreed with the survey item, 14% disagreed with the item, and 14% agreed with the item. Generally speaking, the higher the standard deviation, the greater the variation among responses. For instance, if the standard deviation was 1.0 instead of 0.5, approximately 68% of the responses would range from 2.0 to 4.0 (3.0 ± 1.0), 14% would range from 1.0 to 2.0, and 14% would range from 4.0 to 5.0. In other words, the larger standard deviation indicates more diversity among respondents' ratings of agreement.

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