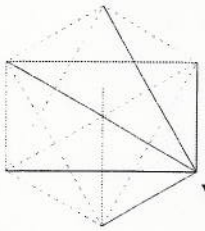


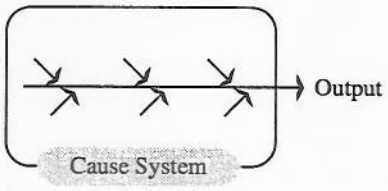
VARIATION

All systems exhibit **VARIATION.**

"Everything is one of a kind."[5]

1. Variation in system resources causes variation in output.

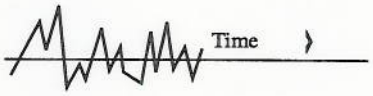
Because of this, we need to measure variation in both the outputs of the system and the system resources. A balanced set of measures includes multiple dimensions, not just one.



Reducing variation in resources is the key to reducing variation in outputs.

2. Variation shows how the system changes over time.

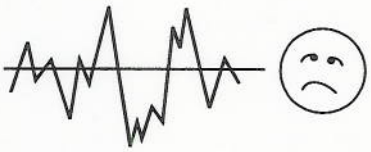
We don't know how a system is performing and is likely to perform for the near term unless we know its variation. Studying variation over time enables us to make improvements in the system, learn from the results, and plan for the future.



For example, Hometown schools could increase enrollment by having fun activities, while learning objectives are un-met.

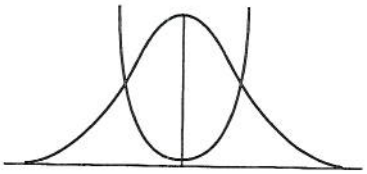
3. Variation in output means inconsistent quality to the customer; reducing variation improves quality.

The consistency of the quality of what we provide customers can be improved only by reducing variation, and variation can be reduced only when we monitor it over time, understand what it's telling us, and take appropriate action.



[5]W. Edwards Deming, *Out of the Crisis*, (Cambridge, MA: Massachusetts Institute of Technology,1988), pg. 94.

Reducing variation gives the organization more control over the level of satisfaction of the customer in each transaction.

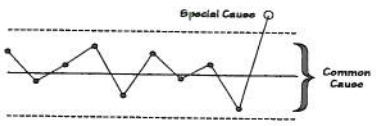


The customer's perception of what is most critical should drive decisions about how to measure outputs. To achieve consistency in outputs in the aspects most important to the customer, consider what characteristics of materials, methods, information aids, equipment, or people are most critical to achieving the desired consistency and measure those characteristics.

4. **Statistical study of variation using control charts separates special from common causes.**

Special cause variation (unstable system) can usually be addressed by people who work *in* the system. Removal of causes of variation that are not part of the *natural* variation of the system will result in a stable (predictable) system.

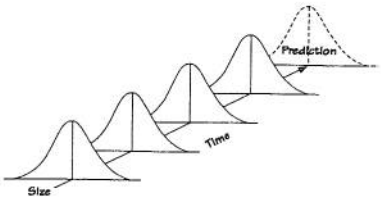
Common cause variation (stable system) is usually addressed through changes to the system by people working *on* the system. A stable system, or one that has only the kind of variation that is inherent in the way the system is designed and consistently managed, can be improved only through fundamental changes to the system. Think of common cause variation as being built in.



Mistaking one cause for the other leads either to inaction or tampering. Either error is likely to degrade system performance.

5. **Stable systems allow managers to predict and plan for the future and to improve the system.**

A stable system produces consistent, predictable output. This enables planning based on data.



In most organizations, managers are responsible for working on the system with the help of employees. Managers control the system and are responsible for driving system changes.

THE VARIATION PRINCIPLE ILLUSTRATED

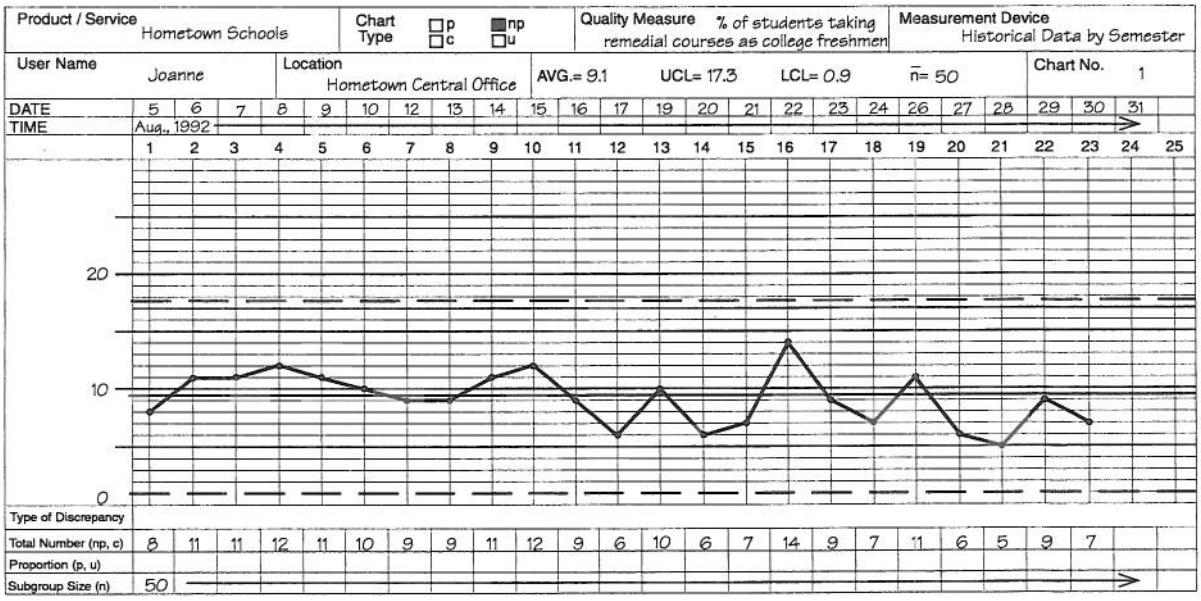
HOMETOWN SCHOOLS - DECIDING WHAT TO MEASURE

The Superintendent's Council referred to the preliminary list of customers, needs, products/services, and expectations. For each expectation, they listed at least one possible output measure to monitor. This is a partial list of their work.

Organization: Hometown Schools		**Product or service: Reports**
Customer	**Expectation**	**Related Output Measure**
State Education Agency	Timely	1. Cycle time to complete 2. % on time
	Accurate	3. # errors reported
	Complete	4. # omissions reported
	Product or service: Learning Experience	
Customer	**Expectation**	**Related Output Measure**
Students	Interesting	1. Student satisfaction
	Relevant	2. % activities with purpose identifiable by learners
	Fun	3. Student satisfaction
	Has variety	4. % experiences in various categories
	Provide choices	5. % experiences offered with alternatives
	Fair	6. Student satisfaction
	Worthwhile	7. Student satisfaction
	Safe	8. # injuries during school hours
	Increases Career Options	9. Rate of job placement 10. Rate of college/university placement

HOMETOWN SCHOOLS
MONITORING KEY OUTPUT MEASURES

Of course, the district could not monitor all the measures which have been identified. Its leaders chose a few key system output measures, based on what is important to customers. At first they plotted data on run charts. Once they had enough data, they converted the run charts to control charts. One of those control charts is shown below. It reflects a stable system, where the variation is coming from common or built-in causes.



OUR QUALITY (OUTPUT) MEASURES

Select one of your organization's products or services. List your customers for that product or service in the left column below. In the middle column, list your customers' expectations regarding the product or service selected. In the right column, list at least one output measure that could be considered for each expectation to determine how well the expectation is being met. Remember to think of output measures in terms of *function, cost, delivery, safety,* and *morale.*

Between today and our next session, bring in existing or collect new data on at least one measure.

Organization:		**Product or service:**
Customer	**Expectation**	**Related Output Measure**

Monitoring Our Key Output Measures

Review the output measures you previously listed. If data is available on any of them, put it in the form of a RUN CHART. If no chronological data (similar to that shown in LeMaster's control chart) is available, plan to gather current data on the most important measure(s). Then put that new data on a RUN CHART.

Convert your RUN CHART(s) to an analyzed CONTROL CHART(s) using:

1. Control Chart Selection Guidelines
2. Control Chart Forms
3. Table of Constants and Formulas for Control Charts
4. Control Chart Interpretation Summary

(See the Appendix)