Small Data: The 5 D's of Dysfunctional KPIs

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Big Data is Worthless without Small Data

"You can't manage what you don't measure.[1]" This adage has often been quoted by anyone who wants to use "science" to achieve their organization's goals. Big data is worthless if you don't have correct "small data." Small data (otherwise known as Key Performance Indicators [KPIs]) allow an organization to measure and monitor the business impact of its big data. However, these KPIs can be misaligned, misapplied, or even misused. The journey of becoming a data driven organization includes identifying the correct metrics and KPIs. Unfortunately, organizations may abandon their KPIs due to one or more of the Five D's of Dysfunctional KPIs, and this will cause them to be forever doomed to mediocre performance.

This paper details those five D's of dysfunctional KPIs, and contains a section on how to measure quality. Since many organizations do not have a clear delineation between metrics and KPIs, guidelines for determining metrics and KPIs are also provided. Detailed steps show how to fix the five D's, and the seven steps to KPI success are outlined so that you can have a checklist for creating your own KPIs.

Working Definition for Big Data

For this paper, the working definition of big data will be all structured, semi-structured and unstructured data. The data may reside in a data swamp, a shadow IT server, on a user's laptop, or in an enterprise data warehouse.

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Understanding the Five D's

Organizations can fall victim to one or more of these "five D's of dysfunctional KPIs" and this can discourage organizations from creating, or refining, KPIs in the future. Let's look at those dysfunctional KPIs.

Deluge of KPIs

A deluge of KPIs occurs when there are too many KPIs to keep track of. (Note: some of the KPIs are probably metrics that are not important enough to be "key."[2,3,4,5]) Organizations that aggressively identify too many metrics and KPIs will create unintended issues. (See "Drowsy KPI") Let's take a moment to explain the difference.

Metric

A dimension or quantity that can be expressed as a number.[6]

KPI

"KPIs are performance metrics explicitly linked to a strategic objective that helps an organization translate strategy execution into quantifiable terms."[7] KPIs can be defined by examining each of the three words in reverse order:[8]

- **Indicator**: A metric that can be measured, and show trends over time.[9] All KPIs are metrics, but not all metrics are KPIs.

- **Performance**: The KPI directly affects the organization's performance. Not meeting the KPI means that the organization will not meet its goals.

- **Key**: The word "key" indicates that it is a crucial item that will indicate, or possibly predict, the performance of the organization. There should not be an overlap or replication between KPIs. The word "key" should be overemphasized when selecting a KPI. Many organizations fail to separate their metrics from their KPIs and therefore they hinder their ability to focus on the "key" indicators. Regarding the ideal number of KPIs, one guideline is to have somewhere between 20-30 KPIs for the entire organization.[10]

> Many organizations fail to separate their metrics from their KPIs and therefore they hinder their ability to focus on the "key" indicators.

For example, due to regulatory requirements, a utility company had over 100 different measures to "tell them if the power was on or off." It was a lot of work to maintain these measures, but none of them helped the organization make better decisions.[11] Another organization had thousands of KPIs & no way to tell which KPIs were "Key." Many of these so-called KPIs were actually metrics masquerading as KPIs. It is human nature to ignore information if too much is presented at one time.[12] Therefore, a deluge of KPIs encourages people to ignore all KPIs. This is why it is important to have a data strategy within your organization, so that the KPIs line up to actually measure the items that *tie directly* to the important business initiatives.

Duplicitous KPIs

Duplicitous KPIs can arise when there are multiple conflicting data sources that can be used for the KPI. In extreme cases, one data source could show a favorable KPI, while another data source could show unfavorable results for the same KPI. Here are several causes of duplicitous KPIs.

Data Drift

The incredible productivity that Excel offers also means that organizations are one mouse click away from making a great decision or a terrible decision. In fact, 1% to 5% of the cells in a typical Excel spreadsheet have errors.[13] Studies have also shown that 86% to 100% of Excel spreadsheets have errors in some portions, and some of these spreadsheets had "extremely serious errors."[14] Since most Excel spreadsheets tend to be snapshots of what the data looked like at a specific point in time, and since anyone with the proper permissions can change any value in an Excel spreadsheet, the data can "drift" from one spreadsheet to another. Organizations that use Excel spreadsheets as the data source for their metrics and KPIs can fall prey to data drift.

Spreadmarts

A shadow IT organization is created when a user takes matters into their own hands, and creates their own mini-IT infrastructure. Shadow IT organizations can extract, store, and manipulate data in their servers or take data from the data warehouse to load into their own environments (i.e. spreadmarts) and this is often done without

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adherence to master data management, governance, or other corporate standards. According to a 2008 TDWI report, greater than 90% of organizations had spreadmarts.[15] The result of this is the KPI could vary if pulled from spreadmart A vs. spreadmart B vs. the corporate system. That's why it's important to have a single source of the business. If you do not have the right level of *data integration*, then you will have serious data and reporting inconsistencies across your organization.

Disparate (siloed) datamarts

An application-centric infrastructure results in each application spawning its own separate database. While this may seem logical, issues arise when there are multiple applications with similar data that is stored in disparate datamarts. The KPI could show favorable results from datamart A, but unfavorable results from datamart B. As an example, we have seen a multi-billion dollar organization continually place data governance on the back burner, and continue to struggle with conflicting data.

Data Swamps

The advent of Hadoop has led to the creation of many data swamps (some refer to these as data "lakes", but if there is no governance within the body then it is more likely compared to a swamp than a lake (interesting note: the goal state is to develop a data "reservoir", but that is for another discussion). If the source data for the metrics and KPIs reside in a data swamp, then there may be multiple conflicting inputs for each metric or KPI. Data swamps still need data governance (especially for the data that will be used to make crucial decisions for the organization).

Disconnected KPIs

In some organizations, the KPIs are disconnected and do not "roll up and flow down" from business to operations to process to individuals. Organizations that have quarterly bonuses often base these bonuses on the achievement of a sales goal as well as "various KPIs." Corporate employees can see the attainment of these goals as out of their control, and may not even know how their individual performance affects these KPIs. Ideally, the KPIs should flow down throughout the organization so that if each individual achieves their annual objectives, then the organization will achieve its objective. In practice, it is difficult, or impossible, to map every individual's annual objectives to the organization's objectives, but the closer an organization can get to this ideal state, the better chance it has of obtaining its goals.

Drowsy KPI

A drowsy KPI does not prompt any action. Drowsy KPIs are usually a symptom of one or more of the other "D's." A deluge of KPIs will cause people to ignore many, or all, of the KPIs. Duplicitous KPIs can cause people to doubt the integrity of the data and results. Disconnected KPIs can cause people to not take any action since achieving the KPI does not appear to be linked to their individual success.

Detour KPIs

A detour KPI causes the organization's behavior to go down a road that was not expected. The KPI can be met by adopting unacceptable quality levels, ignoring other important functions, or fostering unwanted behaviors. Since quality and quantity are often inversely related, the natural reaction is to lower quality in order to meet the quantity goal of the KPI.[16] Also, people may take a detour from the desired behaviors and only focus on obtaining the KPI. This is another reason why it is so important to conduct quarterly KPI reviews. Enforcing some KPIs may steer individuals towards undesirable behaviors, or may measure items that are not associated with the goals.

While it is easy to measure quantity, it is very difficult for the average person to measure quality. Since quality and quantity are often inversely related, the natural reaction is to lower quality in order to meet the quantity goal.[17] Additionally since a person's job may have many dimensions, it is also a natural reaction to neglect the areas that are not being measured.[18] Neglecting these areas may have an adverse effect on either the employees or the customers, and this effect may not show up in the predetermined KPIs. The following account depicts how KPIs can foster undesirable behavior.

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A Detour down the Wrong Path

In 2005, the website Crikey.com.au ran a letter from an anonymous public servant reporting their experience with management by KPI.

"Early in June our manager discovered we were a few percentage points away from meeting operational requirements for the financial year. Rather than explain to his boss that staff cannot perform well when there are continual computer problems and weekly changes in procedures and priorities, he instituted a series of ludicrous schemes to improve the statistics,'' the person wrote.

"Any work that was already 'out of time' was placed on the back-burner, not to be touched until after July 1, when it would be counted in the next year's statistics. In other words, work that was overdue would not even be looked at for another fortnight.

"For two days staff did nothing but go through their files searching for cases that could be closed without further action, or referred to another area. We achieved absolutely nothing in terms of genuine output for those two days, but our percentage of resolved cases skyrocketed. We then started on the new work, but only worked on simple cases that could be closed well within the acceptable operational time frame.

"On June 30 our manager proudly announced that we had achieved operational requirements.''[19]

Although the above case may seem extreme, this behavior is common. **KPIs and the behaviors they incite need to be regularly reviewed**. Not just to ensure that they are being measured correctly, but to also help ensure they are tied directly to the important business initiatives of your organization. Just as the circus clown redirects the air in a partially filled balloon to create a balloon animal, some individuals will redirect their efforts to achieve the KPI. The amount of time and energy (air in the balloon) that someone has is limited, so their time and energy is redirected to fulfilling the KPI. This may result in other areas being neglected. Quarterly KPI reviews should include a conversation regarding which behaviors are being encouraged and which behaviors are being discouraged and/ or neglected. The next section provides details on how to avoid, or minimize, the five D's of dysfunctional KPIs.

Measuring quality

There is often an inverse relationship between quantity and quality. If the KPI requires a specific quantity, then the easiest way to achieve this KPI is by lowering the quality. Therefore, the KPI may need a quality dimension added to it. Unfortunately, many people do not know how to measure (quantify) the degree of quality. (See Appendix for more information on measuring quality.)
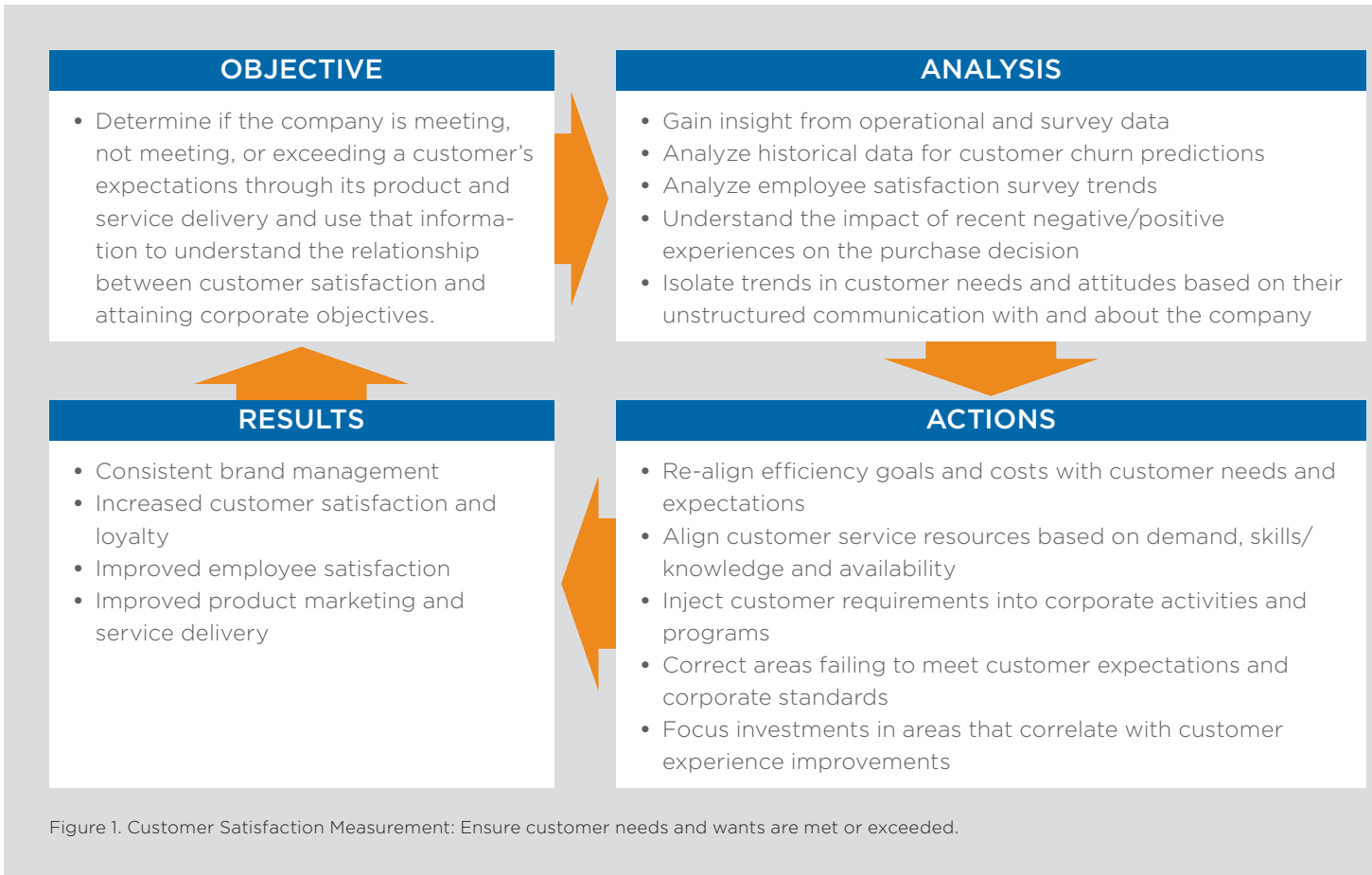
Fixing the Five D's

Organizations may abandon their KPIs due to one or more of the 5 D's and this may cause them to be forever doomed to mediocre performance. In order to make this section tangible, customer satisfaction metrics and KPIs will be used as examples. Figure 1 shows a framework that will help you identify key business improvement opportunities (BIOs). The business objectives are analyzed, distilled into actions, and the actions yield the results. This process has been successfully used to assist many organizations.

After listing the business objectives, the operational, process, and individual metrics are determined. The Business- Operations-Process-Individual tree (BOPI tree) is a great tool to ensure that the metrics and KPIs do not conflict within the organization. The following paragraphs describe how the BOPI tree is used for customer satisfaction metrics and KPIs.

Business

The business layer is at the top of the KPI tree, and this level is most important for **economic survival** over the next five years. There are usually between two and five upper level business objectives. Examples of business objectives include percent market share, return on net assets, customer satisfaction...). As stated earlier, this paper will use the business objective of customer satisfaction as an illustrative example.[20]

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OBJECTIVE

- Determine if the company is meeting, not meeting, or exceeding a customer's expectations through its product and service delivery and use that information to understand the relationship between customer satisfaction and attaining corporate objectives.

ANALYSIS

- Gain insight from operational and survey data
- Analyze historical data for customer churn predictions
- Analyze employee satisfaction survey trends
- Understand the impact of recent negative/positive experiences on the purchase decision
- Isolate trends in customer needs and attitudes based on their unstructured communication with and about the company

RESULTS

- Consistent brand management
- Increased customer satisfaction and loyalty
- Improved employee satisfaction
- Improved product marketing and service delivery

ACTIONS

- Re-align efficiency goals and costs with customer needs and expectations
- Align customer service resources based on demand, skills/ knowledge and availability
- Inject customer requirements into corporate activities and programs
- Correct areas failing to meet customer expectations and corporate standards
- Focus investments in areas that correlate with customer experience improvements

Figure 1. Customer Satisfaction Measurement: Ensure customer needs and wants are met or exceeded.

Operations

This level focuses on the **Operational metrics** that relate directly to customer satisfaction. An example of this involves increasing customer satisfaction by 78% via improving late deliveries, warranty returns...[21])

Process

The level is associated with **key products, services, or transactions**. A six sigma example is to realize no more than 3.4 defects per million opportunities for telephone hold time. The hold time threshold may be 20 seconds. One solution is that anyone whose hold time is predicted to exceed 20 seconds should be provided a "call back" option so that a defect can be avoided.[22])

Individual

This level is a **key adjustment point** where concrete actions take place. This metric or KPI can be applied at the team, department, or individual level. Individuals need to be designated as responsible, accountable, consulted, or informed.[23] An example of this is to reduce software, hardware, & human performance gaps to achieve an average telephone hold time goal of less than 10 sec. Notice that the process level dictates a 20 second hold time as the *threshold* for a defect, but the individual level dictates a 10 second average hold time. The process and individual metrics need to work together to achieve the desired result. In addition, **several managers should be responsible for this "10 second average hold time goal" in their annual objectives**.

Ideally each metric and KPI will flow down from the top and "roll up" from the bottom. The illustrative mapping in Figure 2 shows how this can be achieved. Remember that there will be a mixture of metrics and KPIs in this flow, and only the "key" performance metrics will be promoted to KPI status. Figure 2 displays the KPIs in blue and the metrics in gray. The difficulty of creating an actionable KPI increases as one moves towards the bottom of the
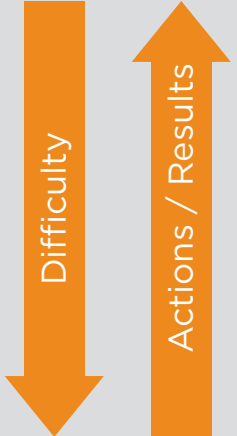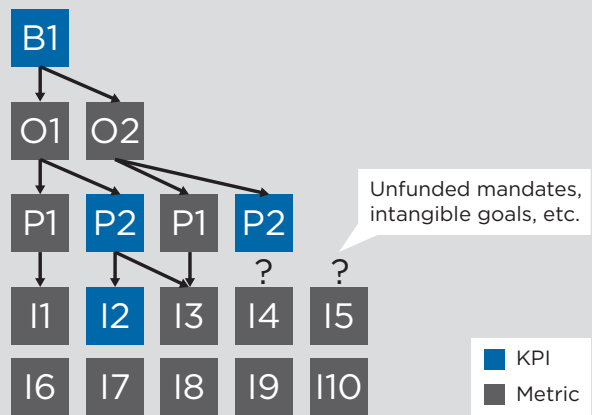
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Figure 2. KPI Trees: Rollup and Flowdown.

diagram. In addition, the actions that individuals take at the bottom of the diagram must translate into results at the upper levels. The question marks for I4, I5, I9 & I10 show that some individual positions may not lend themselves to quantification at this time. (Be aware that premature quantification of a person's actions may lead to undesirable behaviors.) That said, the vision should be quantifying everyone's job while avoiding the 5 D's. "Starter" KPIs and metrics can be implemented with the understanding that they will be fine-tuned (or demoted to a metric) via future quarterly KPI reviews. For examples of KPIs, see Appendix.

Big Garbage in, Garbage KPIs

The age old rule of "garbage in—garbage out" is amplified once the organization becomes dependent on KPIs. The accuracy of each small data KPI is totally dependent on the condition of the relevant big data.

Determining the correct metrics and KPIs is only the first step for some organizations. Once the small data KPIs gain more visibility, any problems with the big data become painfully obvious. The problems with duplicitous

KPIs: Data drift via excel spreadsheets, the proliferation of spreadmarts, disparate (siloed) datamarts, and data swamps all inhibit one view of the truth, leading to duplicitous KPIs, which are deceptive and do not reflect reality.[24]

Big data is worthless if you don't have correct "small data" and small data (KPIs) are incorrect if you don't have proper data governance for the "big data." The symbiotic relationship between small data (KPIs) is crucial for success. Fixing big data and small data problems are not in the scope of this paper, for more insight see:

- **Developing a data strategy; The Seven Common Strategic Mistakes**
- **The Definitive Guide to the Data Lake**
- **Big Data**

Just as a GPS with incorrect source data will lead you to the wrong destination, a small data KPI based on incorrect big data can keep you from achieving your business goals.

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Measure/KPI Name
Measure name

Measure/KPI Name Ref. Number
Unique code for I.D.

Measurement Intent
Describe what outcome this measure is linked to.

Frequency of Update
How often is the KPI produced? Daily, weekly, monthly, etc.

Units of Measure
Percentage, hours, count, etc.

Data Elements and Sources
What are the data sources? Detail this right down to where a source spreadsheet is located, which tab and which column the data is located. It should be sufficiently detailed to allow a novice to locate the data unassisted.

KPI Data Availability
It is automatically generated or does it require high levels of manual input? Is substantial data cleansing part of the production process?

KPI Production Owner
Name and contact details here

KPI Definition/Formula
A precise description, including formula and calculations.

Notes and Assumptions
What issues are there with the data? Are there situations in which there are known limitations or errors?

KPI Targets

Target
Describe what outcome this measure is linked to.

Source For, and Approach To, Setting Targets
On what basis is the largest set? An assessment of what's physically possible, an arbitrary percentage increase/decrease?

Person Accountable for Target Set
Name here

Person Responsible for Tracking and Reporting Targets
Name here

Person Responsible for Target Setting
Name here

Reporting the KPI

Person Accountable
Name here

Person Responsible
Name here

People Consulted
Names here

People Informed
Names here

Driving the Performance Behind the KPI

Person Accountable
Name here

Person Responsible
Name here

People Consulted
Names here

People Informed
Names here

Figure 3. KPI Definition Worksheet.

Each KPI should be documented. Figure 3 shows a template from "Made to Measure KPIs," and this is an excellent example of the information needed to document each KPI. One strength of this template lies in the far right hand column. Each KPI has specific people listed who are accountable, responsible, consulted, or informed. This division of responsibility occurs at both the reporting level and the "driving the performance" level. This is obviously a lot of work if the company has many KPIs, but the thankfully the thoroughness of this form serves as a deterrent to creating too many KPIs.[25]

Many KPIs are designed with a pass/fail mentality. Anything above a certain level is good, and anything below that level is bad. While this is appropriate for some KPIs, other KPIs have a middle range that is acceptable. The control chart in Figure 4 depicts how the upper control limit (UCL) and the lower control limit (LCL) are used to show the acceptable range for the KPI. Anything below the LCL is unacceptable, and anything above the UCL is unacceptable. Figure 4 shows that too many leads from a direct mail campaign can be wasteful, and not enough leads from a direct mail campaign will not yield the volume necessary to meet the upper level sales quota. In short, more is not always better. Giving a salesperson 1000 leads will foster a set of negative issues (i.e. customers may complain that the salespeople never returned their call. "…How can I trust this company to provide good customer service if they won't even return a request for a sales call?"). On the other hand, if a salesperson only receives two leads, they will not be able to achieve their quota. The UCL/LCL approach provides a range of acceptable values. This UCL/LCL approach should lead to fewer "Detour KPIs" since there is not a pass/fail mentality, and the acceptable range can be widened or narrowed during the quarterly KPI reviews.
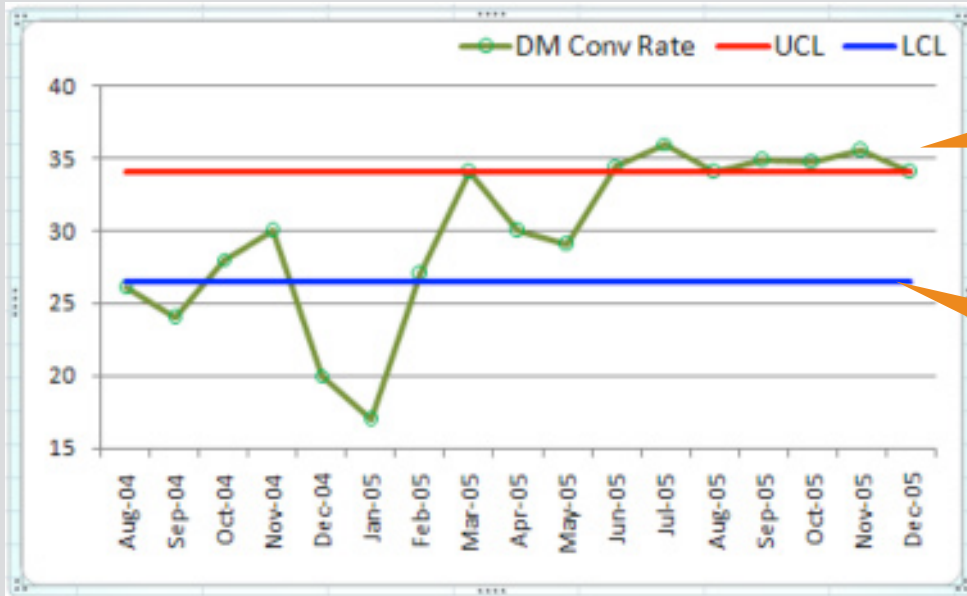
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DM Conv Rate — **UCL** — **LCL**

> Too many leads for salespeople (not enough time to pursue all of the leads)

> Not enough leads for salespeople

Figure 4. Use control charts to signal the optimal range.

Now that suggestions have been provided for "fixing the five D's," here is a summary of the seven steps to KPI success.

7 Steps to KPI success

Developing KPIs in a conference room and then bludgeoning employees with untested final KPIs seldom obtains favorable long-term results. Instead, incorporate the KPI process in conjunction with your data strategy. That way, all KPIs, data projects, etc. will be tied directly to achieving the corporate initiatives. Below are seven steps you can take to increase the likelihood of successful KPIs.

1. Determine the internal "cost" of enforcing new KPIs. Will the corporate culture easily support new KPIs? Is there any "KPI baggage" from the past that needs to be addressed? Work with the human resources and marketing departments to create an internal communication plan (or frequently asked question list) to address potential "KPI baggage."

2. Use the Business Improvement Opportunity (BIO) framework to list the two to five key business objectives for your organization. (see Figure 1)

3. Determine the BOPI tree for each business objective as shown in Figure 2. This will create a long list of metrics.

4. Determine which 20-30 of the metrics from step three are worthy of KPI status. Go through the list of metrics several times to ensure that only KPIs are chosen. Next, make sure that only correct data are used for metrics and KPIs.

5. Complete the KPI template in Figure 3. This template can also be used for metrics.

6. Determine if each KPI warrants a pass/fail approach or if the UCL/LCL approach is more appropriate (see Figure 4).

7. Conduct quarterly KPI reviews. During the quarterly KPI reviews, appoint one person to play "devil's advocate" who will attempt to kill each KPI. This "devil's advocate" role should rotate among group members, and there will be one of three outcomes. Keep the KPI, improve the KPI, or kill the KPI. The quarterly KPI reviews are an excellent time to adjust the pass/fail or UCL/LCL threshold for each KPI. As stated earlier, this is also the time to adjust the KPI so that an individual's actions will mirror the goals of the organization.

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About the Author

Dan Simerlink has over 20 years' experience in the technology industry and is a Business Value Consultant for Teradata. As an Adjunct Professor for Indiana Wesleyan University, Dan has a PhD in Knowledge Management and has assisted scores of graduate level executives in strategic planning, pricing theory, statistics, and financial analysis.

Appendix

Measuring Quality

Often there is an inverse relationship between quantity and quality. If the KPI requires a greater quantity, then the easiest way to achieve this KPI is by lowering the quality. Therefore, the KPI may need a quality dimension added to it. Unfortunately, many people do not know how to quantify the degree of quality. Six Sigma is one discipline that allows for quality measurement and improvement. The following table shows how the sigma levels translate into defects per million opportunities.[26]

Sigma Performance Levels: One to Six Sigma	
Sigma Level	Defects Per Million Opportunities (DPMO)
1	690,000
2	308,537
3	66,807
4	6,210
5	233
6	3.4

One often-quoted example of measuring quality involves the airline industry. For example, baggage handling is usually a 3-4 sigma process, but the chances that you will arrive at your destination alive is a 7-12 sigma process.[27] Since lost luggage incurs a cost to the customer service department and the luggage may need to be transported to the customer's hotel, there have been discussions regarding whether it would be more cost effective to improve the quality level of baggage handling. In short, the airline industry has a reliable method of measuring quality, and they can decide the degree of quality that meets their customer's expectations while still achieving their financial goals.

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The following table includes additional examples such as pieces of mail lost, empty coffee pots at work, number of dropped calls, and erroneous business orders. Notice how the number of defects dramatically changes between the one sigma, three sigma, and six sigma worlds.[28]

Real-world Performance Levels			
Situation/Example	In 1 Sigma World	In 3 Sigma World	In 6 Sigma World
Pieces of your mail lost per year [1,600 opportunities per year]	1,106	107	Less than 1
Number of empty coffee pots at work (who didn't fill the coffee pot again?) [680 opportunities per year]	470	45	Less than 1
Number of telephone disconnections [7,000 talk minutes]	4,839	467	0.02
Erroneous business orders [250,000 opportunities per year]	172,924	16,694	0.9

This appendix briefly covered how to measure quality. Remember that if a metric or KPI is only based on quantity, then a quality measurement may need to be added.

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