



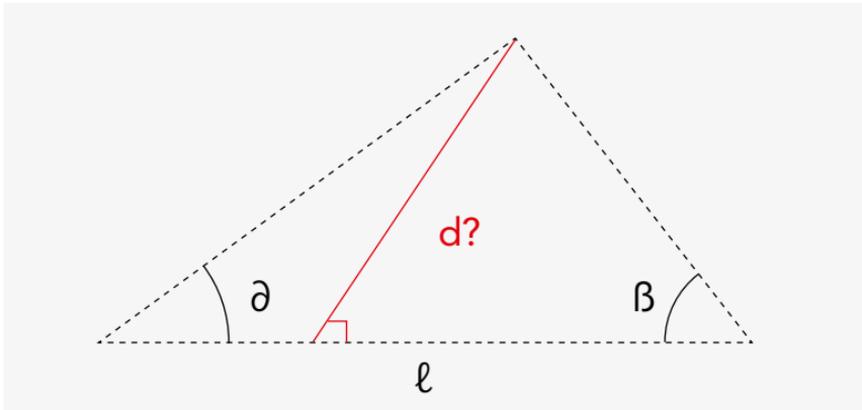
# THE FUNDAMENTALS

The greater the triangulation, the greater  
the confidence in the observed findings.

*Norman Denzin*

## WHAT IS TRIANGULATION?

Triangulation is a method used to determine the location of a fixed point based on the laws of trigonometry. These laws state that if one side and two angles of a triangle are known, the other two sides and angle of that triangle can be calculated.



The exact origins of triangulation are not known, but it was widely used by civilizations in ancient Egypt and Greece. Over the centuries, triangulation was commonly associated with maritime navigation, where sailors used it to track their position and course. Historically, it has also played an essential role in surveying and civil engineering.

In addition, triangulation is the principle behind the GPS or Global Positioning System technology. A GPS receiver processes radio signals sent from four different satellites to determine longitude, latitude and altitude. (In theory, the signals from three satellites could be used to fix the location; however, four are used in order to improve the precision of the measurement.)

Triangulation extended beyond its mathematical roots in the 1970s when it began to be used as a sociological method. In this new sector, triangulation was defined as a process of combining data from different sources to study a particular social phenomenon. In 1978, Norman Denzin identified four basic types of triangulation: (1) data triangulation: the use of multiple data sources in a single study; (2) investigator triangulation: the use of multiple investigators/researchers to study a particular phenomenon; (3) theory triangulation: the use of multiple perspectives to interpret the results of a study; and (4) methodological triangulation: the use of multiple methods to conduct a study.

Since the 1970s, triangulation has become widely accepted as a way to improve the analysis and interpretation of findings from various types of studies. More specifically, triangulation has proved to be an effective tool for reviewing and corroborating findings in the surveys, assessments, appraisals, etc., that are an essential part of effective monitoring and evaluation.

## WHAT ARE THE DIFFERENT TYPES OF TRIANGULATION?

Among experts in triangulation in the social sciences, there continues to be a general consensus on the usefulness of the four types of triangulation originally identified by Denzin in the 1970s: (1) data triangulation; (2) investigator triangulation; (3) theory triangulation; and (4) methodological or method triangulation.

**Data triangulation** is the use of a variety of data sources, including time, space and persons, in a study. Findings can be corroborated and any weaknesses in the data can be compensated for by the strengths of other data, thereby increasing the validity and reliability of the results. The approach has been used in many sectors to strengthen conclusions about findings and to reduce the risk of false interpretations.

- In a large capital city, three different nongovernmental organizations (NGOs) run comprehensive prevention projects for hotel-based sex workers. Each programme works in a different part of the city where there are multiple hotels that rent space to sex workers and their clients. The projects are generally similar, but the dynamics in each community are slightly different. Triangulating performance data from across these three projects (e.g. frequency of contact with sex workers, percentage of sex acts including proper use of a condom, reduction in prevalence of sexually transmitted infections (STIs) among sex workers) will provide a much clearer picture of the overall situation than simply reviewing the data from one programme and attempting to extrapolate broader lessons from those data.

**Methods triangulation** is the use of multiple methods to study a situation or phenomenon. The intention is to decrease the deficiencies and biases that come from any single method. In other words,

the strengths of one method may compensate for the weaknesses of another. This type of triangulation is very similar to the mixed method approaches used in social science research, where the results from one method are used to enhance, augment and clarify the results of another. It is also a variation on data triangulation, with an emphasis on using data collected by different methods as opposed to data collected for different programmes, locations, populations, etc.

- A country has excellent quantitative data on the availability of age-appropriate HIV and AIDS curricula in its primary and secondary schools. It has equally good quantitative data on the number of teachers trained to deliver these curricula. It also has three separate qualitative studies involving extensive focus group discussions with young people reached by the curricula. Triangulation of the findings from the various data collection methods will highlight the strengths and weaknesses of the different methods and will give the triangulation team more insight than any one method is likely to provide.

**Investigator triangulation** is the use of more than one investigator, interviewer, observer, researcher or data analyst in a study. The ability to confirm findings across investigators — without prior discussion or collaboration between them — can significantly enhance the credibility of the findings. Investigator triangulation is particularly important for decreasing bias in gathering, reporting and/or analysing study data.

- Investigators from a condom social marketing project, a local university and a family planning NGO looked at the issue of condom access and condom use among rural populations in a mid-sized country. Each investigator reached different conclusions on the issues. Triangulating the findings from the three investigators allows their approaches, biases and findings to be directly compared and

contrasted and to identify opportunities to launch and/or improve interventions. (Investigator triangulation can also be used very specifically in the analysis of data. In this case, several different investigators would be asked to interpret the same data sets and to provide their independent analysis for further comparison.)

**Theory triangulation** is the use of multiple theories or hypotheses when examining a situation or phenomenon. The idea is to look at a situation/phenomenon from different perspectives, through different lenses, with different questions in mind. The different theories or hypotheses do not have to be similar or compatible; in fact, the more divergent they are, the more likely they are to identify different issues and/or concerns.

- Needle sharing continues to be very high in a border town with a large number of injecting drug users (IDUs). One study of the situation is based on the premise that social norms among these local IDUs encourages sharing as a way to show trust. Another study presumes that existing needle exchange projects are simply not providing enough clean needles to meet a high demand. A third study is looking at the correlation between intense police activity, the corresponding need for IDUs to stay on the move to avoid arrest and the efficiency of sharing drugs and needles. Each theory/hypothesis may be correct; triangulation is an opportunity to compare and contrast the findings from each of them and identify relevant lessons for improving interventions with IDUs.

There are other types of triangulation used in the social sciences — for example, data analysis triangulation (i.e. the combination of two or more methods of analysing data) — but the four types mentioned above are the most common and the most widely used.

It is useful to distinguish triangulation from meta-analysis. Meta-analysis combines the original data from several rigorous scientific studies of similar quality and design for sophisticated statistical analysis. In contrast, triangulation uses findings from diverse sources, bearing in mind the strengths and weaknesses of those findings, and it looks for a convergence of the evidence in order to draw overall conclusions.

**IMPORTANT NOTE:** Although data triangulation is only one type of triangulation, it is the most commonly used type. In this book, the term 'triangulation' will generally be used as the common descriptor; 'data triangulation' will be used in reference to that specific type of triangulation.

## **WHAT ARE THE STRENGTHS AND WEAKNESS OF THE FOUR TYPES OF TRIANGULATION?**

In general, triangulation can enhance the validity and reliability of existing observations about a given situation. If findings converge, it can also generate new, credible findings about a situation or phenomenon and can create new ways of looking at a situation or phenomenon. Most importantly, it can provide a better understanding of a situation or phenomenon.

However, the many strengths of triangulation are counterbalanced by a number of major challenges, including: the amount of additional time required to conduct triangulation activities; the complexities of dealing with large quantities of data; the potential conflicts between different investigators, theories/hypotheses and/or methods; the difficulties of interpretation when data do not converge into a clean, clear picture; and limited understanding among policy/decision-makers about how triangulation works and why it was used in a given situation.

Ironically, it is as possible to do too much triangulation as it is to do not enough. It is also difficult to balance the routine use of triangulation with its use on an ad hoc basis; ideally, triangulation should be institutionalized within the national M&E system, whether it is used on a routine or ad hoc basis. Overall, triangulation is only effective if it is approached as a rigorous and demanding activity.

**Institutionalizing triangulation.** One key to institutionalizing triangulation is identifying capable and credible organizations that will effectively 'own' the process. In other words, these organizations would have primary responsibility for ensuring the consistent and high-quality use of triangulation to provide useful data on the country's HIV response. For example, a partnership between the M&E unit in the National AIDS Commission and an umbrella NGO would provide the structure and support needed to institutionalize triangulation in a country. Another key to institutionalizing triangulation is to include it in existing M&E systems. In Malawi, triangulation is included in the annual M&E workplan. Equally important, following a successful triangulation initiative, there is now an annual budget dedicated to triangulation activities.

### **Data triangulation**

The core strength of data triangulation is the use of existing data for review and analysis. Rather than drawing conclusions from a single study, data triangulation — by definition — uses multiple data sources to examine a situation. A larger pool of relevant data practically guarantees that areas of convergence and divergence will be discovered; areas of convergence and divergence that may not have been identified or noticed in the data from a single study. A parallel strength is the nature of the data when they are drawn from multiple data sources and data sets. With triangulation, it is likely that the data will be drawn from a much more diverse set of sources and this diversity ensures a more expansive look at the situation.

The weaknesses of data triangulation tend to be related to the quantity and quality of the data. For example, having too few data

means that triangulation is unlikely to provide any meaningful insights. In addition, poor quality data can completely undermine the usefulness of triangulation. There can also be serious problems with data triangulation if qualitative data are analysed from a quantitative perspective. Qualitative data are best analysed using the more flexible qualitative methodologies that look for deeper meaning in individual responses and/or data sets. However, it is not uncommon to code qualitative data in ways that make them more compatible with quantitative findings. This too can lead to false or misleading analysis.

### **Methods triangulation**

The core strength of methods triangulation is its potential to expose unique differences or meaningful information that may have remained undiscovered with the use of only one approach or data collection technique in the study. Combining quantitative and qualitative methods enhances the ability of analysts to rule out rival explanations of change and improves the validity and reliability of change-related findings. For example, qualitative findings may help explain the success of an intervention when the quantitative data — the numbers — do not provide any corollary information. Many experts believe that across-method and within-method triangulation provide far richer findings than reliance on a single method.

Methods triangulation has several weaknesses, including the expense of deploying multiple/mixed methods, the challenges of meshing quantitative and qualitative findings and the varying quality of different studies using different methods. With methods triangulation, it is critical to remember during analysis that inaccuracies of data from one method do not necessarily lessen or offset the inaccuracies of data from a different method. This is precisely why it is so important to use proven methods for both quantitative and qualitative work.

### **Investigator triangulation**

A key strength of investigator triangulation is the reduction of bias in gathering, reporting and analysing data. There is a general sense that having multiple investigators not only reduces bias but can also have a positive impact on both validity and reliability. Also, most investigators are skilled at one type of research and/or data collection methodology; for example, an investigator is most adept at either quantitative or qualitative research. Having multiple investigators using different methodologies, which would actually include investigator triangulation and methods triangulation, would also ensure a broader and potentially more balanced perspective on the situation being examined. In addition, corroborating data and verifying their interpretation across multiple investigators can increase the value of the findings.

While a reduction in bias is a strength of investigator triangulation, it can be a weakness as well. For example, different investigators may be resistant or overreact to the known perspective of other investigators, undermining the objectivity of their own findings. Also, if different investigators are working with the same subpopulation, it is possible that conflicts could arise, which would be disruptive to the studies.

### **Theoretical triangulation**

The primary strength of theoretical triangulation is its ability to look deeper and more broadly at findings. Specifically, using only one theory, perspective or hypothesis can decrease the number of alternative explanations for a situation or phenomenon. In fact, using multiple — even rival — perspectives or hypotheses can challenge analysts to look beyond obvious explanations and identify sharper ways of examining and explaining findings.

If the theories and/or hypotheses being used in theoretical triangulation are not well defined, this type of triangulation can be confusing and unproductive. It is also possible that the use of opposing theories/hypotheses in triangulation could be equally confusing and unproductive. Conversely, analysts must remember that findings are not automatically more credible because they have been supported by similar theories/hypotheses. While all types of triangulation must be very carefully managed in order to ensure that the process has integrity and the results are credible, there is a heightened need for vigilance with theoretical triangulation.

## WHY DO TRIANGULATION?

“The use of triangulation strategies does not strengthen a flawed study. Researchers should use triangulation if it can contribute to understanding the phenomenon; however, they must be able to articulate why the strategy is being used and how it might enhance the study.”

*Veronica Thurmond*

Triangulation can only be done when data are available, whether they are data from different sources, different investigators, different theories or different methods. However, when data are available, there are a number of different reasons why triangulation can and should be used.

**Complex questions.** When seeking to answer complex questions concerning the quality, implementation, outcome and impact of a programme, the ability to draw from multiple inputs can provide a wider range of information and a significantly broader insight into the issues underlying the complex questions.

**Dissimilar data.** When there are sufficient data but they are dissimilar, triangulation can balance the different perspectives and lead to a valid conclusion or a new hypothesis that can be tested. In fact, triangulation can create opportunities to compare a wide range of data on a particular situation or phenomenon side by side, providing new insights and generating new hypotheses.

**Poor-quality data.** When relevant data from different sources, investigators and methods are available, triangulation can compensate

for the poor quality of some of the data, assuming that the validity and reliability of the other data can be confirmed.

**Insufficient data.** When directly applicable data are not available, triangulation may be able to use indirectly applicable data to draw a valid conclusion. However, in these cases it is important to consider additional ways to confirm the accuracy of the conclusion.

**Trend data.** When examining trend data on the epidemic and response, triangulating from a range of data types and sources can provide a more precise picture of the overall trend.

**Rapid response.** When there is a need to rapidly respond to a situation, triangulation — using readily available data — can provide a valid perspective far more quickly than collecting and analysing new data.

**Alternative to research.** When the findings from a rigorous, specifically designed research study are not available and when such a study is not feasible, triangulation – again, using available data – can be a viable option, depending on the depth and breadth of the available data.

**Estimates of population-level outcomes.** When no data on population-level outcomes are available, triangulation can be used to piece together population-level conclusions using the available data on subsets of the population.

It is important to stress that triangulation can and should be an institutionalized component of monitoring and evaluation. It is possible and desirable to plan to use multiple inputs for triangulation on a regular/recurring basis. However, when specific needs or opportunities arise – e.g., an urgent request to understand the effectiveness of an intervention in order to include those findings in a funding

proposal – it is also possible and desirable to conduct a focused triangulation exercise.

**Triangulation in Botswana.** In recent years, triangulation has been used very effectively in Botswana. The benefits have been twofold. First, using pre-existing data enables the work to be done relatively rapidly, which means the findings are more timely and, consequently, more useful. Second, using data from multiple sources has identified new issues to be studied and has provided a valuable check on the quality of data, including a reduced likelihood of data and researcher bias.

## QUANTITATIVE VERSUS QUALITATIVE DATA

There are two basic types of data: quantitative and qualitative. Both types of data are equally useful in any triangulation activity. In fact, the use of both types of data is an underlying premise of triangulation.

Quantitative data can be measured on a numerical scale and can be analysed using statistical methods and displayed using tables, charts, histograms and graphs. The essential steps in a quantitative exercise are to classify features, count them and construct statistical models in an attempt to explain what is observed. Quantitative data are collected using quantitative methods such as systematic surveys, tests and analysis of records.

Qualitative data are not intended or designed to be measured, counted or expressed in numbers. As the term implies, they relate to the quality or character of something and provide an understanding of social situations and interactions, as well as people's values, beliefs, opinions, perceptions, motivations, behaviours and reactions. Qualitative data are generally expressed in words, pictures or objects and are collected using qualitative methods such as interviews and observation.

There are limitations to quantitative and qualitative data. For example, inappropriate sampling can compromise the validity and reliability of both types of data. In addition, quantitative data will never accurately reflect certain aspects of situations (e.g. the motivations behind risk-taking behaviours). Qualitative data can similarly misrepresent the magnitude of the situation (e.g. the percentage of a population at higher risk of engaging in risky behaviour).

## THE DIFFERENCES BETWEEN QUANTITATIVE AND QUALITATIVE DATA

Quantitative data	Qualitative data
<ul style="list-style-type: none"><li>• Numbers as data</li><li>• Ask: How many? How much?</li><li>• Data collected through surveys</li><li>• Generalizability is a goal</li><li>• Use probability sampling</li><li>• Use a large sample size</li><li>• Goal: prove/verify</li></ul>	<ul style="list-style-type: none"><li>• Words as data</li><li>• Ask: How? Why?</li><li>• Data collected through interviews and observation</li><li>• Generalizability is not a goal</li><li>• Use purposive, convenience, snowball, or quota sampling</li><li>• Use a small sample size</li><li>• Goal: discover/explore</li></ul>

## **DATA SOURCES**

There are many sources for the quantitative and qualitative data used in triangulation. The categories include – but are not limited to – research initiatives, surveillance, surveys, programme records, focus groups, ethnographies, census reports and grey literature. The following table gives examples of specific data sources from different categories. It is not an exhaustive list; there are many different data sources.

## EXAMPLES OF SPECIFIC DATA SOURCES FROM DIFFERENT CATEGORIES

Data source category	Specific data source examples
<b>Demographic</b>	<ul style="list-style-type: none"> <li>• National census</li> <li>• Demographic and Health Surveys (DHS)</li> <li>• AIDS Information Surveys (AIS)</li> </ul>
<b>Surveillance</b>	<ul style="list-style-type: none"> <li>• Seroprevalence surveys (e.g. sentinel surveillance, population-based surveys)</li> <li>• Case reporting</li> <li>• Demographic and Health Surveys (DHS)</li> <li>• AIDS Information Surveys (AIS)</li> <li>• Behavioural surveillance surveys (BSS)</li> <li>• Integrated bio-behavioural surveillance surveys (IBBS)</li> </ul>
<b>Qualitative</b>	<ul style="list-style-type: none"> <li>• Focus groups</li> <li>• Ethnographies</li> <li>• Rapid assessments</li> </ul>
<b>Programme records</b>	<ul style="list-style-type: none"> <li>• Annual reports, quarterly reports, patient/client records, reviews, interviews, surveys, mapping, etc.</li> </ul>

<b>Evaluation and research</b>	<ul style="list-style-type: none"> <li>• Published papers and/or reports</li> </ul>
<b>Grey literature</b>	<ul style="list-style-type: none"> <li>• Abstracts from conferences</li> <li>• Programme/project evaluations</li> <li>• Technical reports</li> <li>• Unpublished research papers</li> <li>• Websites</li> <li>• White papers</li> <li>• Working papers</li> <li>• Preprints or drafts of scientific papers</li> </ul>

It is important to assess the validity and reliability of the data available from different sources. For example, review the sampling method and sample size, determine if there is any bias and evaluate the data quality. If there is a high level of confidence in the data, regardless of the source, the data's usefulness in triangulation increases. Conversely, if the level of confidence in the data is low – even if the source is well known – then the data are likely to be less useful for triangulation. However, it is important to remember that a lower confidence level does not necessarily invalidate data. In triangulation, the objective is to combine the full range of reliable data to identify patterns and convergence, and then reach the most accurate conclusion.

## DETERMINING THE USEFULNESS OF DATA

The usefulness of data to answer a specific triangulation question is dependent on the quality and integrity of the data. When evaluating the usefulness of a data set, it is worth considering the following questions:

**How representative are the data?** For data to be useful in triangulation, they must be representative of the target population (e.g. general population, sex workers, injecting drug users) and their location (e.g. urban, rural). Determining how representative data are may require a review of the sampling methods (e.g. probability and non-probability) and sampling approaches (e.g. cluster, random or convenience) that were used to obtain the data.

**What are the biases in the data?** Bias is common in data sets of all types. However, it is important to understand the bias before using data in triangulation. There are several different types of bias, but observer, confounding and selection bias are three of the most common.

- **Observer bias** is when the investigator's subjective perspective may influence the objectivity of the data. In ethnographic research, the people being studied are described by the researcher through his or her own cultural thought system, using the researcher's own terminology.
- **Confounding bias** occurs when the dependent variable of interest is associated with two or more independent variables that are associated with each other. For example, people associating the transmission of malaria (the dependent variable of interest) with eating mangoes (independent variable 1), as mangoes are often available during the rainy season (independent variable 2), when

malaria is more prevalent. (Although mangoes do not transmit malaria, they are available in the rainy season, when malaria is more prevalent. Assuming mangoes and malaria are associated would be a confounding bias error.)

- **Selection bias** occurs when people selected for a study do not reflect the population of interest. For example, HIV prevalence among blood donors cannot be used as a measure of overall prevalence in a country because blood donors are not necessarily reflective of the overall population.

**Were the data collection methods consistent?** Unfortunately, methods for data collection can change over time; for example, if a new programme manager or new organization assumes responsibility for data collection, they may change the method used by their predecessor. However, the consistency of data collection is crucial, particularly for an accurate modelling of trend data. Consequently, data collection methods should be reviewed to determine if they have been consistent and, if not, how significant the changes are.

**Were the data collected according to ethical standards?** The data used in triangulation should be collected ethically; this will include, when necessary, approval by an institutional review board (IRB). The following issues should be addressed when evaluating the ethics of data collection:

- Study participants provided informed consent.
- Confidentiality was guaranteed for participants.
- The risk of stigma and discrimination for participants was not increased.
- There was no increased risk of harm for populations at higher risk, especially if their behaviour is illegal (e.g. sex work or injecting drug use).

- Participants had access to prevention, treatment and care services.
- Standards of professional conduct, practice and the manner in which the studies were consistent with the relevant international, national, and local laws and guidelines.

The ethical principles used in public health settings are described in the Belmont Report,<sup>1</sup> the Helsinki Agreement,<sup>2</sup> the Council for International Organizations of Medical Sciences guidelines<sup>3</sup> and UNAIDS guidelines.<sup>4</sup>

1 Belmont Report. Available at: [www.hhs.gov/ohrp/humansubjects/guidance/belmont.htm](http://www.hhs.gov/ohrp/humansubjects/guidance/belmont.htm).

2 Helsinki Agreement. Available at: [www.wma.net/e/policy/b3.htm](http://www.wma.net/e/policy/b3.htm).

3 Council for International Organizations of Medical Sciences. *International Ethical Guidelines for Biomedical Research involving Human Subjects*. Geneva, Council for International Organizations of Medical Sciences, 2002. Available at: [www.cioms.ch/frame\\_guidelines\\_nov\\_2002.htm](http://www.cioms.ch/frame_guidelines_nov_2002.htm).

4 UNAIDS. *Guidelines on Protecting the Confidentiality and Security of HIV Information*. Geneva, UNAIDS, 2007. Available at: [http://data.unaids.org/pub/manual/2007/confidentiality\\_security\\_interim\\_guidelines\\_15may2007\\_en.pdf](http://data.unaids.org/pub/manual/2007/confidentiality_security_interim_guidelines_15may2007_en.pdf)