

# Designing an Effective Survey

Mark Kasunic

*September 2005*

HANDBOOK  
CMU/SEI-2005-HB-004





**CarnegieMellon**  
**Software Engineering Institute**

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## **Designing an Effective Survey**

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Mark Kasunic

*September 2005*

**Software Engineering Measurement and Analysis**

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# Abstract

A survey can characterize the knowledge, attitudes, and behaviors of a large group of people through the study of a subset of them. However, to protect the validity of conclusions drawn from a survey, certain procedures *must* be followed throughout the process of designing, developing, and distributing the survey questionnaire.

Surveys are used extensively by software and systems engineering organizations to provide insight into complex issues, assist with problem solving, and support effective decision making.

This document presents a seven-stage, end-to-end process for conducting a survey.



---

# Document Overview

|                                   |  |
|-----------------------------------|--|
| <b>Introduction</b>               | <p>Survey-based research can be used to characterize the knowledge, attitudes, and behaviors of a large group of people through the study of a subset of them. For this reason, surveys are used extensively by software and systems engineering organizations to provide insight into complex issues, assist with problem-solving, and support effective decision making.</p>   |
| <b>Objective of this document</b> | <p>A survey is the collection of data using a standardized questionnaire. In this document, the survey is described as a seven-stage process.</p> <p>The objective of this document is to show people how to conduct a survey. An end-to-end process is outlined that describes each stage. By following the process, you will end up with a successful survey.</p>  |
| <b>Intended audiences</b>         | <p>The <i>primary audience</i> for this document is individuals who are, or will be, responsible for designing and developing a survey. But, as discussed in upcoming sections, an effective survey is typically the result of a team effort. All survey team members would benefit from understanding the survey process approach described in this document.</p> <p>The <i>secondary audience</i> for this document is individuals who read and use survey results. Knowing the details of the survey process can help them judge whether the survey method used to produce the results was competent.</p> |
| <b>Document format</b>            | <p>This document was designed to support a broad audience of readers with varying information needs. Each page is labeled at the top to show readers where they are in the document. Information is chunked and labeled to support scanning, while also providing accessible detail to those who have a more comprehensive need for information.</p> <p>A number of sections contain overviews that provide information relevant for the upcoming subsections. The overviews also act as information organizers to provide readers with advance notice of what to expect in those section.</p>               |

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## Document Overview (continued)

### Document organization

The document is organized into the following main sections:

- What is Survey Research?
- The Survey Research Process
- After the Survey

The “What is Survey Research?” section provides an introduction for those who might be wondering if a survey is the best way to conduct their research. The strengths and limitations of surveys are discussed in that section.

The core substance of this document is contained in the “Survey Research Process” section. The process is described as a seven-stage approach and is discussed in seven subsections.

The “After the Survey” section briefly discusses typical post-survey activities.

### In this document

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# What is Survey Research?

## Introduction

Using surveys is one way to conduct research. But before you decide to invest your time and resources in the survey approach, consider whether a survey is the best way to find out what you want to know.

This section describes survey research and why you might want to use it for your research project.

## Approaches to data gathering

Survey research is but one approach for collecting information to gain insight into people or problems under study. Other approaches include

- documentary research
- laboratory experiments
- action research
- case studies
- field experiments
- field work (e.g., participant observation and ethnography)
- simulation
- in-depth interviews

There are strengths and weaknesses to each approach. For a description and comparison of these approaches, see Appendix A on page 111.

## What is a survey?

A *survey* is a data-gathering and analysis approach in which respondents answer questions or respond to statements that were developed in advance. In this document, the approach is described as a seven-stage process that includes the following steps:

1. Identify the research objectives.
2. Identify and characterize the target audience.
3. Design the sampling plan.
4. Design and write the questionnaire.
5. Pilot test the questionnaire.
6. Distribute the questionnaire.
7. Analyze the results and write a report.

## What distinguishes a survey from other approaches?

Surveys differ from other kinds of data-gathering approaches in an important way. A survey, when conducted properly, allows you to *generalize* about the beliefs and opinions of many people by studying a subset of them. However, a survey can only be used for generalization when the survey process follows strict procedures, as discussed in this document beginning on page 7.

---

## What is Survey Research? (continued)

### Are questionnaires and surveys the same?

Very often, the terms “questionnaire” and “survey” are used to mean the same thing. However, there is a subtle but important distinction between the two.

A survey is a process. This document describes a *seven-stage process* for conducting a survey. The instrument of a survey is the *questionnaire*.

While surveys always make use of a questionnaire, it is the survey process itself that determines whether the information obtained through the questionnaire is valid and can be used to generalize about the population that the sample is intended to represent.

Surveys must be implemented following strict guidelines and procedures. Failure to follow these guidelines can lead to misleading results that can be challenged and refuted. Developing and distributing a questionnaire in a haphazard fashion is not the same as using a well-constructed questionnaire within a carefully designed survey process

### Types of surveys

Surveys fall into two broad categories:

- self-administered questionnaires
- interviews (distinguished from in-depth interviews, defined on page 5)

### Self-administered questionnaires

When most people think of a survey, they think of a self-administered questionnaire. This survey is the kind you might receive through the mail or complete on a set of Internet Web pages.

This document focuses on developing self-administered questionnaires.

### Interviews

A survey *interview* is one in which the interviewer asks questions from a prepared questionnaire and records the information. Interviews can be conducted by the researcher working directly with the respondent face-to-face or by telephone. An obvious disadvantage of this method is that it is both time-consuming and costly for the researcher. You would likely need a team of trained interviewers to conduct the survey interviews.

We will not discuss interviewing methods and the skills required to implement interviews in this document. Oishi provides a detailed discussion of interviewing skills associated with surveys [Oishi 02].

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## What is Survey Research? (continued)

### Comment: survey interviews vs. in-depth interviews

Survey interviews are distinguished from in-depth interviews by their objectives and by the way in which they are conducted.

In *survey interviews*, the researcher works from a questionnaire and the questions are presented to each respondent in exactly the same way. The objective is to make the interviews as repeatable as possible so that the results can be quantified and compared.

When conducting *in-depth interviews*, the researcher may work from a list of topics and possible questions, but the interview is free-flowing and controlled as much by the respondent as it is by the researcher. Unanticipated issues might arise during the course of the interview and might need to be addressed by new questions the researcher did not plan.

### In-depth interviews as a prelude to a survey

Quite often, conducting several in-depth interviews with subject matter experts as a prelude to designing a survey instrument is valuable. This is especially important when the topic areas are fuzzy and not well-understood.

In-depth interviews can help the researcher define relevant survey questions that would be otherwise overlooked.

### Characteristics of surveys

The following table<sup>1</sup> summarizes important characteristics of surveys.

| Characteristic | Description   |
|----------------|---|
| Systematic     | The survey follows a specific set of rules; a formal and orderly logic of operations.   |
| Impartial      | The survey selects units of the population without prejudice or preference.   |
| Representative | The survey includes units that together are representative of the problem under study and the population affected by it.                                    |
| Theory-Based   | The survey's operations are guided by relevant principles of human behavior and mathematical laws of probability and statistics.                            |
| Quantitative   | The survey assigns numerical values to non-numerical characteristics of human behavior in ways that permit uniform interpretation of these characteristics. |
| Replicable     | Other people using the same methods in the same ways can get essentially the same results.  |

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<sup>1</sup> Information from this table is adapted from Backstrom [Backstrom 81, (pages 3-4)].

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## What is Survey Research? (continued)

### Limitations of surveys

While surveys can provide significant advantages over other data-collecting approaches, there are certain limitations that should be understood.

- To generalize for a population, a survey *must* follow strict procedures in defining which participants are studied and how they are selected.
- Following the rules and implementing the survey with the rigor that is necessary can be expensive with respect to cost and time.
- Survey data is usually superficial [Backstrom 81]. It is not typically possible to go into any detail—that is, we are not capable of digging deeply into people’s psyches looking for fundamental explanations of their unique understandings or behaviors.
- Surveys can be obtrusive. People are fully aware that they are the subjects of a study. They often respond differently than they might if they were unaware of the researcher’s interest in them.

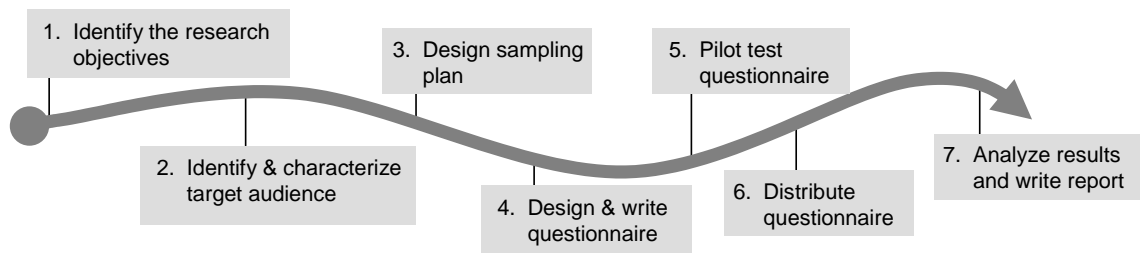
Information is self-reported and is not always the undiluted truth.



# The Survey Research Process—Overview

## Introduction

This section provides an overview of the seven-stage survey research process.



| Stage                                     | Description   |
|---|---|
| 1 Identify research objectives            | What do you want the survey to accomplish? What information already exists about the problem you are asking questions about? Survey research must begin with a statement of the problem and how the survey will answer questions about the problem.                             |
| 2 Identify & characterize target audience | Who, specifically, will respond to the survey? What assumptions can you make about their knowledge of the questions you have in mind, the terminology they understand, their willingness to participate in the survey, and so forth?  |
| 3 Design sampling plan                    | How big is the target audience population? Can the target audience be enumerated? How will you ensure that those who respond to the survey are representative of the target audience?   |
| 4 Design & write questionnaire            | The survey objectives and internal questions must be translated into carefully-worded questionnaire items crafted to facilitate analysis and interpretation.  |
| 5 Pilot test questionnaire                | The questionnaire instrument must be “tested” with members of the target audience to remove bugs and improve the instrument.  |
| 6 Distribute the questionnaire            | The questionnaire should be distributed to selected members of the target audience as defined by the sampling plan.   |
| 7 Analyze results and write report        | The results should be collected and translated into appropriate graphical displays that facilitate understanding. The charts can be compiled into a report and interpretations, inferences, generalizations, and caveats can be made based on evidence provided by the results. |

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## The Survey Research Process—Overview (continued)

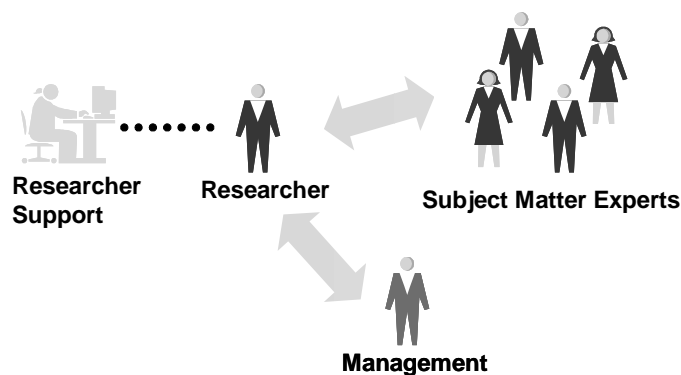
### The need for a process perspective

As stated by the preeminent statistician, W. Edwards Deming:

The information that a statistical survey or experiment provides is not right because someone agrees with it, nor wrong because he does not; the information is useful or not useful depending on the information and the questions that were built in initially in the statement of the problem, and on the skill that went into the preparation, execution, and summary of the survey or experiment. The burden rests with the expert in the subject-matter, and with management, in the preparation of the questionnaire or of the method of test, to get information that they can apply to the problem when the results of the survey or experiment come in. [Deming 60]

Dr. Deming makes several important points.

1. It is the survey process that determines whether the results will be useful.
2. A useful survey is the product of several kinds of knowledge working skillfully together. You need both of the following:
  - survey design knowledge (with statistical knowledge and skills)
  - subject matter expertise in the domain under investigationSurvey design theory is not a substitute for the knowledge of a subject matter expert. Conversely, knowledge in the subject matter will not ensure that an effective survey will be developed. You must have both.
3. Those who will use the survey information to support decision-making (typically management) bear a responsibility in the survey research process—to ensure that the survey is asking the questions that will lead to problem understanding and effective decision-making.



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## The Survey Research Process—Overview (continued)

### Team approach is typically needed

A successful survey is typically a team-based effort. A team is needed since, in most cases, no single individual has all the knowledge and skills required. The following table describes the key roles and responsibilities in a survey research project.

| Role                          | Responsibility   |
|-------------------------------|--|
| Researcher                    | <ul style="list-style-type: none"><li>• survey design and statistics expertise</li><li>• owner and facilitator of the survey process; author of the survey plan</li><li>• ensures adherence to tenets of good survey design</li><li>• becomes familiar enough with the domain under investigation to ensure that survey objectives are addressed</li><li>• translates internal questions into questionnaire items</li><li>• distributes questionnaire and monitors response information</li><li>• analyzes results and authors the survey report</li></ul> |
| Subject matter experts        | <ul style="list-style-type: none"><li>• domain knowledge expertise</li><li>• define objectives of the survey research</li><li>• develop internal questions<sup>2</sup> that address the objectives</li><li>• ensure survey questionnaire items address objectives</li><li>• review all intermediate and final products of the survey process and provide feedback</li><li>• participate in pre-testing of the survey instrument</li></ul>  |
| Management                    | <ul style="list-style-type: none"><li>• approves the survey objectives</li><li>• decides what action will be taken given various survey result outcomes</li><li>• may develop internal questions that address the objectives</li><li>• reviews all intermediate and final products of the survey process and provides feedback</li></ul>   |
| Researcher support (examples) | <ul style="list-style-type: none"><li>• computer programming support provided for Web-based survey</li><li>• administrative support provided for mail-type survey</li><li>• technical writers and graphic designers on your team can significantly improve the quality of your survey products</li></ul>   |

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<sup>2</sup> *Internal questions* are those that the subject matter experts (or management) have that are related to the survey objectives. However, these questions typically need to be broken into more than a single question, simplified, reworded, and translated into closed-ended questions before they can be used on the respondent questionnaire as *questionnaire items*.

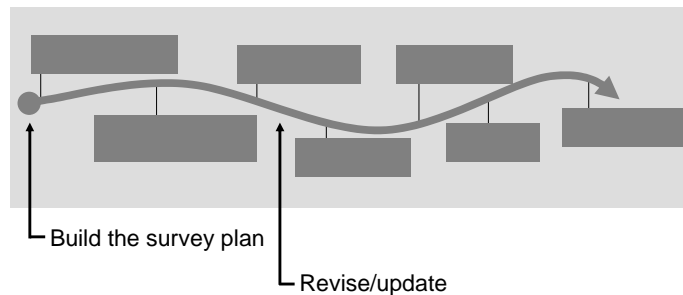
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## The Survey Research Process—Overview (continued)

### Need for a plan

To set the stage for effective collaboration, the researcher should develop a plan that guides the effort and establishes a shared understanding among the participants.

The first version of the plan should be written at the beginning of the project. This helps to set team members' expectations so that informed commitments can be made. The plan should be revised and updated as new information becomes known, such as the details of the sampling plan. The plan should be revised when there are changes and kept under version control.



### Components of survey plan

The components of the survey plan are listed below.

| Plan component       | Description  |
|----------------------|--|
| Objectives           | objectives of the survey research  |
| Team members & roles | <ul style="list-style-type: none"><li>• team member responsibilities</li><li>• time committed to project</li></ul>                   |
| Target audience      | <ul style="list-style-type: none"><li>• specific target audience of survey</li><li>• assumptions about the target audience</li></ul> |
| Sampling approach    | the approach for selecting the target audience population who will participate in the survey   |
| Media                | how the survey will be mediated (e.g., mail, email, Web-based, telephone)  |
| Activities           | description of survey process activities and how each team member will participate in the activity                                   |
| Schedule             | activity milestones  |
| Product              | how the survey results will be reported (e.g., in a report or presentation, or both)   |

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## The Survey Research Process—Overview (continued)

### **Work breakdown structure**

A schedule is a component of a survey plan. An example activity breakdown structure is provided in Appendix C on page 119. Activity durations are not provided in Appendix C because they depend on factors such as the scope of the survey research project.

### **What about a quick and dirty survey?**

Has anyone ever said to you, “Having some data is better than nothing”? This thinking is sometimes used to justify a rush to write up a quick and dirty questionnaire to obtain some information. But the assertion that “having some data is better than nothing” is fraught with error.

The problem with a quick and dirty survey is that you have no notion of how valid or reliable your results are. You may be lucky and have developed a good questionnaire—or, you may be unlucky. But, the point is, you just won’t know unless you follow a methodical procedure designed to mitigate threats to measurement validity.

After the survey results are in, you are left in a quandary. Does the survey fail to show differences because they do not exist? Or, is it simply that the survey was insensitive because it wasn’t executed in a way that would lead to coherent and analyzable information? If the results do show differences, is it because the questionnaire is biased, or is it because there are real statistical differences? The crux of the matter here is that you cannot know unless you follow the principles of good survey design.

So the statement, “Having some data is better than nothing,” can certainly be wrong. It is wrong because if the data are invalid, then it could lead you to make false conclusions and wrong decisions. In such a case, it might have been better to forego the cost of conducting the quick and dirty survey—because it is no more reliable than your guess of what the survey outcome would be.

### **Survey design: a key concern**

To protect the *validity* of conclusions drawn from the information resulting from a survey, strict procedures must be used during the design process.

### **Definition: validity**

“Validity” is defined as the best available approximation to the truth of a given proposition, inference, or conclusion [Trochim 01].

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## The Survey Research Process—Overview (continued)

### Validity of survey results

Validity is a critical concern of survey researchers. It is the survey process itself that provides the foundation for the conclusions drawn by the researcher. Validity is most related to the research process.

There are always threats to validity that the researcher must avoid or minimize through procedure and careful development of the questionnaire instrument. In the absence of these important precautions (which are described in later sections), assertions or conclusions drawn from the survey data may be challenged.

Two important types of validity in survey research are

*construct validity* Are we measuring what we think we are measuring?

*external validity* Can the results be generalized to other people, places, or times?

The body of guidance in this document is intended to provide ways for improving the measurement validity of your survey results.<sup>3</sup>

### In this section

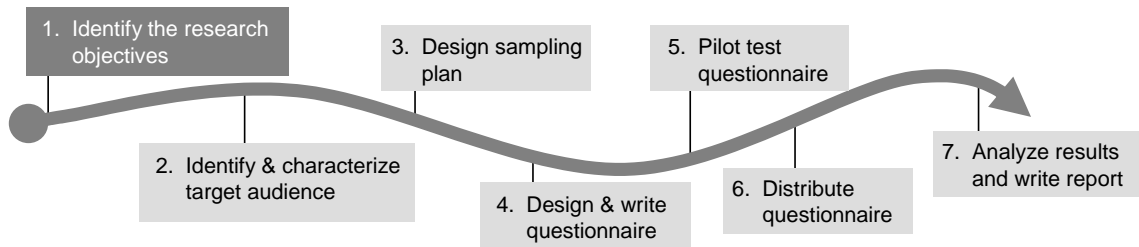
|   | Section                                 | See page |
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| 4 | Design & write questionnaire            | 33       |
| 5 | Pilot test questionnaire                | 75       |
| 6 | Distribute the questionnaire            | 79       |
| 7 | Analyze results and write report        | 83       |

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<sup>3</sup> In particular, information described in substage 4.2.2 beginning on page 48 specifically addresses ways of mitigating threats to construct validity. Stage 3 of the survey process (beginning on page 21) describes procedures that must be applied to support external validity.

---

# 1 Identify the Research Objectives



## Introduction

A natural tendency is to jump into action and begin writing questions for the questionnaire the moment the decision to do a survey is made. However, successful questionnaires result from planning based on a careful examination of the problem that provided the motivation to do the survey in the first place.

## What are survey objectives?

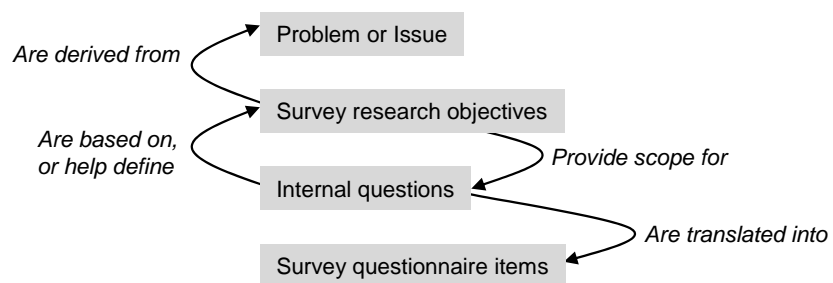
Objectives are derived from a careful understanding of the problem or issue under study.

The survey research objectives provide scope and guidance for internal questions the team has about the problem or issue.

In some cases, team members have difficulty defining objectives but can provide internal questions (sometimes called research questions) that are used to inform the research objectives. This represents a bottom-up sort of thinking where the objectives are defined as a result of first identifying the questions.

Internal questions will not appear in the actual survey questionnaire. Internal questions are seldom expressed in the way a respondent would understand, so they must be translated into the target audience language.

Also, internal questions can be complex and open-ended and must be broken into multiple simpler questionnaire items that are closed-ended. (Although well-scoped carefully worded open-ended questions can also provide useful information when used sparingly.)



---

## 1 Identify the Research Objectives (continued)

### **Why clear objectives are needed**

The research objectives provide the scope and guidance for several aspects of the survey project. They not only determine who the respondents should be, but also what questions should be asked.

Do not make the mistake of assuming that the research objectives are commonly understood by everyone on the team. The objectives must be written down to test whether or not everyone is on the same page. Taking the time to do this in the beginning will help you avoid timely rework later when the questionnaire instrument is being developed.

In some cases, identifying the research objectives is easy and straightforward. In other cases, you might find that there is actually a wide disparity of viewpoints that must be reconciled. Work sessions might be needed to negotiate or clarify what the survey is intended to accomplish.

### **Content of objectives**

Your objectives should state what you intend to accomplish with your survey as clearly as possible. If your objectives are fuzzy or ill-defined, you will struggle when you try to develop appropriate questions and will need to do more work on your objectives.

In addition to documenting what you hope to accomplish with the survey, you should also define and document how the information that results from the survey will be used. This can help you sharpen your thinking about the objectives.

### **Avoid too many objectives**

One of the most common challenges facing researchers is the pressure to expand the scope of the survey research. There are always team members who will view the survey project as an opportunity to collect all kinds of information. Nonetheless, there are practical considerations that limit both the type and amount of information that can be collected using a single survey. These considerations are explained in more detail later the document, but here it suffices to say that there are natural constraints to the size and complexity of questionnaire instruments.

### **Has someone done this before?**

As your objectives take shape, an obvious question to ask is, “Have these research objectives already been addressed by the work of others?” By conducting a literature review, you might find that others have indeed addressed aspects of your problem, if only in part.

Take advantage of the research of others to change or refine your objectives. At the least, other research can be used to inform your objectives and to provide ideas about how you will develop questionnaire items.



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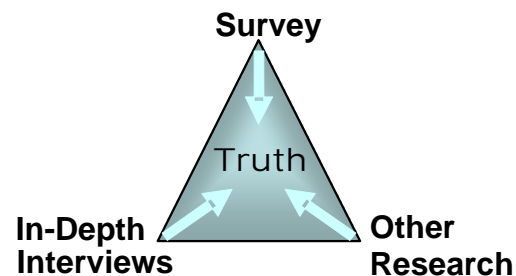
## 1 Identify the Research Objectives (continued)

### **Avoid overzealous objectives**

It is unreasonable to expect to include questions about everything you might want to learn about in a single survey. Your objectives need to set reasonable expectations for what can be accomplished in a single survey.

Typically, a survey cannot provide conclusive answers to all questions you have about a complex problem or issue. This is especially the case for an initial survey, sometimes called an “exploratory survey,” which is one component of an overall research strategy. Follow-on information-gathering activities are used to probe the problem space in order to elicit details about specific aspects of the problem that the initial survey illuminated. These activities might include follow-up surveys or other types of data-collection methods including in-depth interviews, case studies, or literature review.

Researchers refer to this approach as triangulation. Rather than rely on a single data-gathering event to make concrete conclusions, triangulation is used to improve the confidence of assertions made by a single survey.

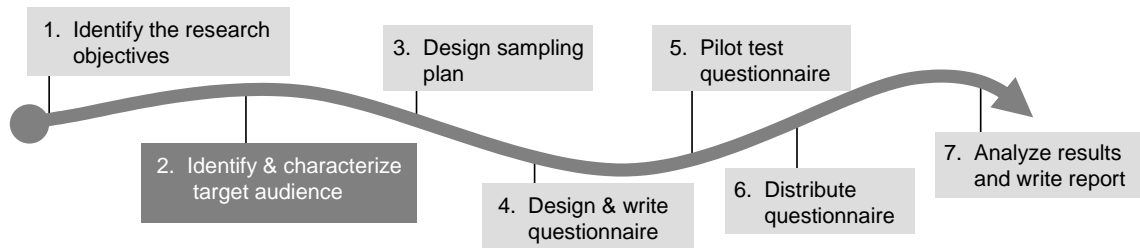


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**1 Identify the Research Objectives (continued)**

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## 2 Identify & Characterize the Target Audience



### Introduction

This stage of the process is a two-step activity that begins with identifying the population you are trying to describe. Once identified, this population is explicitly characterized in ways that assist effective survey development.

### Population vs. sample

In survey research, a “population” refers to all the members of a specific group. A population can be defined in terms of demography, geography, occupation, time, or some combination of these factors.

When you identify the population for your study, it then becomes the *target audience* for the research.

A “sample” is a subset of the population. In survey research, the sample is studied and the findings are generalized to the population. However, this is only possible when strict procedures (described in stage 3) are followed to ensure that the sample is representative of the population.

### Selecting your target audience

Select your target audience based on whose perspective you are interested in obtaining. That is, for the research objectives you have identified, who can best provide you with the information you need? Answering this question will indicate who your population is.

For example, consider the four categories of people that might be part of your organization:

- management
- engineering staff
- financial analysts
- clerical staff

---

## 2 Identify & Characterize the Target Audience (continued)

### Selecting your target audience, continued

For the objectives of a particular survey, you might want the perspectives of only management and engineering staff. So, for these objectives, your population and target audience will include management and engineering staff.

For a different type of survey with different objectives, you might define the population as all four groups, so your target audience will include them all.

Therefore, the target audience you select depends on the problem you are trying to understand and who can provide that information to you. For example, you might be interested in obtaining only the opinions of project managers in companies that perform contracting services for the Department of Defense (DoD).

It is important to be very explicit about who the intended respondents for your survey are. This assumption has a dramatic influence on the design of the survey instrument and the distribution method for the survey.

### Analyzing the audience

Once you have identified the target audience for the survey, conduct an audience analysis to characterize the intended respondents.

An audience analysis is conducted for a number of reasons. Understanding the audience will help you

- choose the method of surveying (e.g., paper and pencil, survey interview, Web-based questionnaire) that will most likely lead to high response rates and valid response information
- develop questionnaire items that can be interpreted by the respondents

### Understanding the target audience

Developing questionnaire items that can be interpreted by the respondents is particularly important and is worthy of additional elaboration. Questionnaire items *must* be written from the perspective of the respondent, not the perspective of the researcher.

This means you should ask questions you believe the audience has knowledge about and can answer. Also, it means that special care should be given to writing questionnaire items using vocabulary familiar to the respondent.

### Conducting the audience analysis meeting

In many cases, you might not have insight into the characteristics of the target audience. Even when this is only partially true, it's always a good idea to enlist the help of subject matter experts who can provide opinions about the target audience to augment your existing knowledge base.

Consider holding a team brainstorming meeting to help you characterize the audience.

---

## 2 Identify & Characterize the Target Audience (continued)

### **What you will want to know**

Some example questions you can use to elicit characteristics about the target audience for the survey are listed below.

- How many people are in the population we are studying?
- What are their jobs and responsibilities?
- What is the most common education level?
- What relevant experience do they possess?
- What technical abilities do they possess?
- What is the age range of the respondent population?
- Do we anticipate that they would have difficulty with using a questionnaire that is:
  - mailed to them?
  - completed using a computer via the internet?
  - handed to them?
- What can we assume about their knowledge of the domain we are studying in the survey?
- How do they speak about the domain under study? Do they have a special language they use to talk about the problem space?
- Will they be motivated to complete the questionnaire? Or will they be resistant?

How much of their time can we assume they will spend completing the questionnaire?

### **How is this information used?**

If an item from the questionnaire is misinterpreted by the respondent, the data you obtain through the survey will be erroneous and misleading.

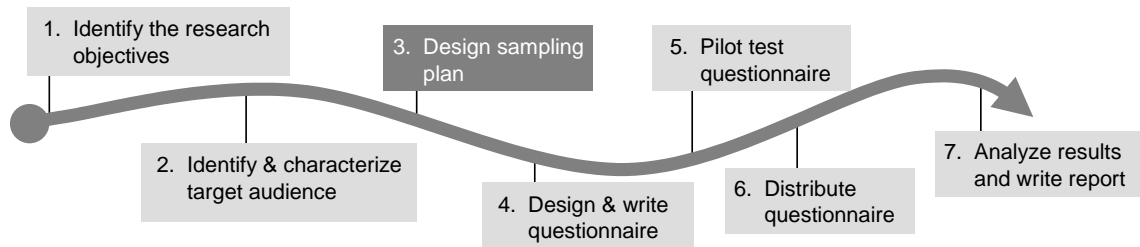
The information derived from the audience analysis is indispensable when you are designing and writing the questionnaire instrument because it will help you understand the precautions you must take to word the questions in a way that the respondent understands.

---

## 2 Identify & Characterize the Target Audience (continued)

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## 3 Design the Sampling Plan



### Introduction

During this stage, the researcher should determine

- how individuals will be selected to participate in the survey
- the required size of the sample

These considerations have significant consequences for how the results can be generalized beyond the sample and for how much precision and confidence you can express about the findings.

### What kind of sample will you select?

During this stage, the researcher determines how the questionnaire will be distributed to the population of potential respondents. Two primary considerations that will drive your decision about this are listed below.

- Are the survey findings intended to be generalized to a larger population? If so, then a *probability sample* will be required.
- Will the survey findings be considered unique to the individuals who participate in the survey? If so, then a *non-probability sample* will suffice.

### Census: a special case

A “census” is a sample that includes all individuals in the population. A census eliminates sampling error and provides information on all individuals in the population. In this case the sample *is* the population.

### What are probability samples?

In statistics, the term “probability” means “chance.” For a population of individuals under study, what is a person’s chance of being selected for the survey?

A probability sample is designed to ensure each person in the population has a fair or equal chance of being selected. In this way, a sample that is representative of the population is obtained.

Probability samples are used so reliable estimates of the whole population can be made (even though not everyone in the population is part of the survey).

---

### 3 Design the Sampling Plan (continued)

#### What are non-probability samples?

A *non-probability sample* uses human judgment in selecting respondents. Such judgmental samples have no theoretical basis for estimating population characteristics. Non-probability samples do not ensure that the sample is representative of the population. These types of samples are referred to in a number of ways, including

- convenience samples
- judgment samples
- self-selecting sample

#### Examples: non-probability samples

Examples of the use of non-probability samples include

- distributing questionnaires to participants at a conference or event
- polling a set of individuals considered to be experts in an area of interest
- distributing questionnaires using the Web and allowing individuals to decide for themselves whether they want to participate (in a probability sample, individuals are randomly selected to participate)

In the examples mentioned above, the findings will apply to *only* those who respond. It would be incorrect to generalize the results to any other people, times, or places.

This is a very important distinction and has been a source of confusion in some surveys that have been conducted and reported in the literature.

#### What's wrong with non-probability samples?

Is there anything wrong with non-probability samples? That depends.

##### Acceptable uses of non-probability samples

When survey findings are unique for a particular set of individuals, a sampling plan is not needed. Individuals are invited to participate in the survey and they do so if they wish.

If the survey results are intended to apply only to a unique set of individuals, it is fine to distribute the questionnaire and report findings, as long as it is clear to readers of the report that inferences and generalizations cannot be made to those outside the respondent group. In other words, the reader of the report should understand that if the questionnaire were distributed to a different set of like-individuals, then a different set of results, perhaps in conflict with the original sample results, could be obtained.

##### Unacceptable uses of non-probability samples

It is **not** acceptable to draw a non-probabilistic sample simply because you are unwilling to spend the effort, time, or money required to draw a true probability sample.

When generalizations from the sample are intended to apply to the population, then a probability sample **must** be used.



---

### 3 Design the Sampling Plan (continued)

**Probability samples reduce bias**

Bias is introduced into surveys when a sample is drawn from a population, but the sample is not representative of the entire population.<sup>4</sup> Whenever predispositions enter into the sampling approach, the data is at risk of becoming biased. A probability sample is based on mathematical laws of chance rather than the researcher's personal values and judgments.

**Self-selection can introduce bias**

When individuals are asked to volunteer to participate in a survey, bias can be introduced. The results obtained through this method can be misleading. You must question whether the individuals who chose to respond to the survey are really representative of the population, or if one of the following scenarios is at play:

- those responding have a special axe to grind so they are taking the time to respond to the survey
- individuals who respond have more slack time than busy people and the sample is skewed in the direction of including more non-busy individuals than those who are over-committed with responsibilities

In both of these examples, there is a high risk that the results obtained from self-selected volunteers would not represent the overall views of the population in which you were interested.

This is why newscasters on television are careful to report the results of call-in polls as non-scientific. The people who take the time and trouble to respond to these polls are not likely to be representative of the population.

**Is there a perfect probability sample?**

No, having a perfect probability sample is not possible. Even a properly designed sampling method will often break down somewhat due to indefinite populations, low response rates, or other related factors. However, despite these breakdowns, you must make every effort to control the influence of personal biases along the way so you will end up as close to a probability sampling design as possible. Deviations from the planned sampling approach must be described in the survey report.

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<sup>4</sup> This is a special form of bias known as "sampling bias." Other types of bias can be introduced through errors in question-writing and in how results are interpreted. These issues are addressed in substage 4.2.2 beginning on page 48 and stage 7 beginning on page 83.

---

### 3 Design the Sampling Plan (continued)

#### **Types of probability samples**

Probability samples can be obtained through a variety of sampling methods, including the following:

- simple random sampling
- systemic sampling
- stratified sampling
- cluster sampling

The specific approach that should be used is determined by different factors, including the following:

- the size and nature of the population
- time and cost involved
- known population characteristics [Backstrom 81]

#### **Simple random sampling**

When the population is a manageable size and can be enumerated, simple random sampling is the most straightforward approach. Since this is the case for most systems and software organizations, random sampling is likely to be the preferred approach and will be discussed in this document.

Other approaches to probability sampling are variants of simple random sampling. You can find out more about these approaches in Backstrom [Backstrom 81].

#### **Drawing a probability sample**

Drawing a simple random sample requires that all members of the population be enumerated. In many cases, doing this is not a problem since organizations maintain databases that list their employees.

Database lists can be imported into common desktop spreadsheet applications that will assign random numbers to each member of the list. Many statistical software packages also have this basic capability.

A simple way to obtain a random sample using a standard desktop spreadsheet application is listed below.

1. List all names associated with the population under study.
2. Assign a random number to each name in an adjacent column.
3. Sort the list of names based on the column of random numbers. Select the individuals from the list beginning at the top until the required sample size has been reached.

---

### 3 Design the Sampling Plan (continued)

#### What should the sample size be?

Thus far, the importance of drawing a representative sample has been discussed, but not how large that sample should be.

The appropriate sample size can be calculated using formulas described later in this section. But, before the equations are presented, you should understand the conceptual underpinnings of the components of the equations.

Determining the appropriate sample size is a function of

- precision desired
- confidence level desired
- population size (when the population size is small)

#### Precision

Precision is a measure of how close an estimate (resulting from the survey data) is to the actual characteristic in the population. Precision is related to the error introduced by estimating characteristics of the population through a sample. In fact, precision and sampling error are the flip sides of the same coin.

$$\text{Sampling error} = 1 - \text{Precision}$$

Of course, all researchers want to increase precision. But, there is a price to pay. As precision increases, so does the sample size—and therein lies the trade-off.

The level of precision depends on the amount of risk you are willing to accept when you use the data to make decisions. You need only the level of precision adequate to make the required decision based on the findings. In some cases, a high degree of precision is desired. In other cases, you might need to sacrifice precision due to the difficulty of obtaining a large sample.

#### Confidence level

Sample size is also a function of *confidence level*. Despite efforts to draw a representative probability sample, there is always some chance of drawing a bad sample (i.e., one that is not truly representative). Therefore, how confident can you be that the sample is a good one, and truly represents the population?

The confidence level tells you how confident you can be that the error toleration does not exceed what was planned for in the precision specification. To understand confidence levels, think of drawing 100 independent samples from the population. How sure do you want to be that the sample is a good one? Specifying a 95% confidence level would imply that if we took 100 independent samples, then 95 out of the 100 would be within the error tolerances specified by the precision. If you have a 99% confidence level, then you can feel confident that 99 out of the 100 samples would provide an estimate within the precision set by the researcher.

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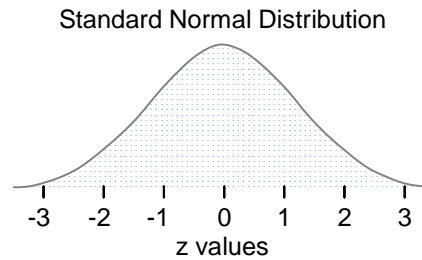
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### 3 Design the Sampling Plan (continued)

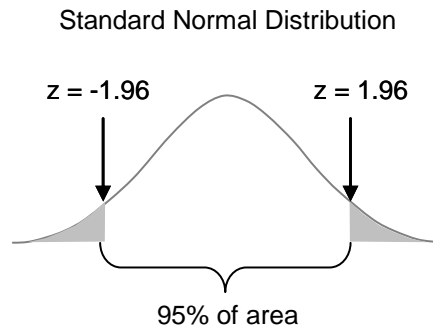
#### Confidence level (continued)

The confidence level is ascertained through the well-established probability model called the Standard Normal Distribution and an associated theorem called the Central Limit Theorem [Feller 68, Kallenberg 97, Trotter 59]. The theory behind the use of the standard normal distribution is taught in basic statistics courses (and courses sometimes taught in secondary school mathematics).

When calculating the sample size, the desired confidence level is specified by the *z-value*. The *z-value* is a point along the abscissa of the standard normal distribution, as shown below.



A given value for *z* specifies an area under the standard normal curve. The figure below illustrates how a *z-value* of 1.96 specifies 95% of the area under the normal curve. This would represent a confidence level of 95%. A *z-value* of 2.58 would specify 99% of the area under the normal curve. In this present context, this *z-value* would specify a confidence level of 99%.



Values for *z* and corresponding normal curve areas can be found in tables supplied in the back of most statistic books. The function is also available in most spreadsheet applications and in all specialized statistical applications.

---

### 3 Design the Sampling Plan (continued)

#### Population size

The size of your population can also affect your sample size calculation, but only when your population becomes small.

There are two different formulas for calculating the sample size depending on whether your population is large or small. These are shown later in this section.

#### Important assumptions

Note that sample size calculations are based on the following assumptions:

- The sample is obtained through simple random sampling (see page 24).
- The sample sizes obtained from the formulas in this section reflect the number of *obtained* responses, not the number of requests for questionnaire responses. Quite often, the sample size used in the survey is increased by 30% to compensate for non-response so that the power of the survey (i.e., precision and confidence level) is not compromised [Israel 92].

#### When your population is large

To calculate your sample size, you must specify the precision and the confidence interval you are willing to accept. Again, the values you specify are based on the amount of risk you are willing to accept that the sample size would be a poor representation of the population. (See the description of precision and confidence level earlier in this section.)

Cochran developed a formula for calculating the sample size from a large population [Cochran 77].

$$n_0 = \frac{z^2 pq}{e^2} \quad (1)$$

where

$n_0$  is the sample size

$z$  is a point on the abscissa of the standard normal curve that specifies the confidence level (see the diagram on page 26).

$p$  is an estimated proportion of an attribute that is present in the population

$q$  is equal to  $(1-p)$

$e$  specifies the desired level of precision where  
 $e = 1 - \textit{precision}$

The mathematical value  $(p*q)$  is an estimate of the variance of the population attribute (assumed to be dichotomous) that you are trying to measure with your survey. Of course, there is no way to really know what this is before measuring it. Therefore, for sample size calculations, this value is always assumed to be the maximum variance.

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*Continued on next page*

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### 3 Design the Sampling Plan (continued)

**When your population is large (continued)**

The maximum variance is represented by the following equation:

$$pq = 0.5 * 0.5 = 0.25$$

This equation represents a case where a questionnaire response attribute is evenly split among the population.

You might be wondering why the calculation assumes a dichotomous response variable (e.g., a response variable that is “yes” or “no”). What about those questions that have a more continuous-type response scale (e.g., a Likert-type scale)? In those case, the sample size equation would be

$$n_o = \frac{z^2 \sigma^2}{e^2} \quad (2)$$

The above formula employs  $\sigma$ , the population variance, instead of  $(p*q)$  as the measure of variability. The disadvantage here is that establishing a **good** estimate of the population variance is necessary to use this formula.

**Example: sample size for large population**

Consider an example where the population size is 8,750 and you would like to draw a representative sample with precision of 95% and a confidence level of 99%. The sample size would be expressed as

$$n_o = \frac{z^2 pq}{e^2} = \frac{2.58^2(0.5 * 0.5)}{0.05^2} = 665.6 \approx 666$$

**Does size matter when population is very large?**

Although it might seem counterintuitive to those without a statistics background, population size becomes irrelevant in surveys because the same mathematical principles of random sampling apply to large and not-so-large populations.

For the same level of precision and confidence, a sample of about 395 people will describe a population of 100,000 people just as well as it will describe a population of 10,000 people. The best way to think about this is through an analogy used for sampling:

*Every cook knows that it only takes a single sip from a well-stirred soup to determine the taste.*



This is a good analogy for sampling because it emphasizes the need for the soup to be well-stirred to produce the *random* sample required if the sample is to represent the population.

Now, using this analogy again, the sip (sample) would determine the taste whether it was from a large pot or a small one. The idea here is that the size of the soup pot doesn't really matter. The sample (sip) represents the population (the pot of soup) whether the population is big or small.

---

### 3 Design the Sampling Plan (continued)

#### When your population is small

The analogy just described only goes so far. When the population size is significantly small, then the size of the pot does begin to matter.

When your population size is small, you can employ the finite population correction (fpc) factor [Cochran 77, Kish 65]. The finite population correction factor is:

$$fpc = \sqrt{\frac{N - n_o}{N - 1}} \quad (3)$$

where

$N$  is the population size

$n_o$  is the sample size (as calculated in equation #1 on page 27).

The finite population correction factor measures how much extra precision is achieved when the sample size becomes close to the population size.

The sample size derived by using the finite population correction factor will be smaller than that derived from the uncorrected equation.

By using the fpc, a revised sample size can be calculated using the following formula:

$$n_R = \frac{n_o}{1 + \frac{(n_o - 1)}{N}} \quad (4)$$

where:

$n_R$  is the revised sample size based on the fpc

$N$  is the population size

$n_o$  is the sample size (as calculated in equation 1 on page 27)

#### When can you use the fpc?

The fpc can be used when the sample size exceeds **10% of the population size** [Kish 65].

---

### 3 Design the Sampling Plan (continued)

**Example:  
using  
the fpc**

Consider the case where:

Population size = 2000

Desired precision = 95%

Confidence interval = 95%

Using equation 1, the sample size is:

$$n_0 = \frac{z^2 pq}{e^2} = \frac{1.96^2 (0.5 * 0.5)}{0.05^2} = 384.1 \approx 384$$

Since  $384/2000 = 19\%$  and  $19\%$  is greater than the fpc threshold criterion of  $10\%$ , using the fpc is permitted.

Therefore, the revised sample size number is

$$n_R = \frac{n_o}{1 + \frac{(n_o - 1)}{N}} = \frac{384}{1 + \frac{(384 - 1)}{2000}} = 322.3 \approx 322$$

Therefore, in this case, you only need to sample 322 individuals (rather than 384) to obtain the same level of precision and confidence.

**A simplified  
formula for  
sample size**

Yamane provides a simplified formula to calculate sample sizes. This simplified formula assumes a 95% confidence level and the maximum variance ( $p = 0.5$ ). The formula is

$$n = \frac{N}{1 + N(e)^2} \tag{5}$$

where

$n$  is the sample size.

$N$  is the population size

$e$  specifies the desired level of precision, where

$$e = 1 - \textit{precision}$$

The table on the next page lists sample sizes for various precision levels using Yamane's formula [Yamane 67].



### 3 Design the Sampling Plan (continued)

**Sample sizes based on the Yamane formula**

The following table presents sample size numbers for various levels of precision and a confidence level of 95% with  $p = 0.5$  (maximum variance).

| Population Size | Precision Level |      |      |       |
|-----------------|-----------------|------|------|-------|
|                 | ± 3%            | ± 5% | ± 7% | ± 10% |
| 100             | *               | 80   | 67   | 50    |
| 125             | *               | 95   | 78   | 56    |
| 150             | *               | 109  | 86   | 60    |
| 175             | *               | 122  | 94   | 64    |
| 200             | *               | 133  | 101  | 67    |
| 225             | *               | 144  | 107  | 69    |
| 250             | *               | 154  | 112  | 71    |
| 275             | *               | 163  | 117  | 73    |
| 300             | *               | 171  | 121  | 75    |
| 500             | *               | 222  | 145  | 83    |
| 600             | *               | 240  | 152  | 86    |
| 700             | *               | 255  | 158  | 88    |
| 800             | *               | 267  | 163  | 89    |
| 900             | *               | 277  | 166  | 90    |
| 1,000           | *               | 286  | 169  | 91    |
| 2,000           | 714             | 333  | 185  | 95    |
| 3,000           | 811             | 353  | 191  | 97    |
| 4,000           | 870             | 364  | 194  | 98    |
| 5,000           | 909             | 370  | 196  | 98    |
| 6,000           | 938             | 375  | 197  | 98    |
| 7,000           | 959             | 378  | 198  | 99    |
| 8,000           | 976             | 381  | 199  | 99    |
| 9,000           | 989             | 383  | 200  | 99    |
| 10,000          | 1,000           | 385  | 200  | 99    |
| 15,000          | 1,034           | 390  | 201  | 99    |
| 20,000          | 1,053           | 392  | 202  | 100   |
| 25,000          | 1,064           | 394  | 202  | 100   |
| 50,000          | 1,087           | 397  | 203  | 100   |
| 100,000         | 1,099           | 398  | 204  | 100   |
| >100000         | 1,111           | 400  | 204  | 100   |

\* For cells containing an asterisk, the assumption of statistical normality is poor and the entire population should be sampled [Yamane 67].

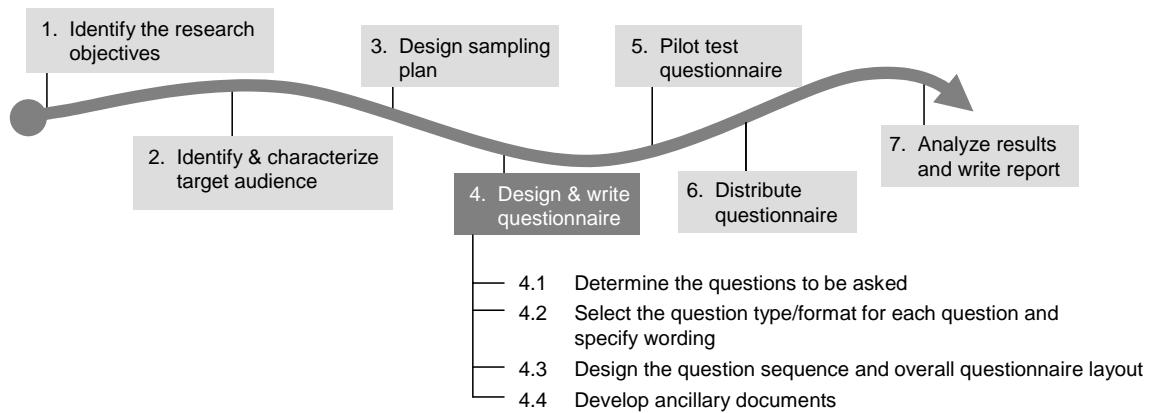
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### 3 Design the Sampling Plan (continued)

#### **Very small populations**

When your population size is very small (less than 200 individuals), you should consider conducting a census [Kish 65]. A “census” is a sample that includes all individuals in the population in the sample. A census eliminates sampling error and provides information on all individuals in the population. For samples of 200 or less, the entire population has to be included in the sample to achieve a desirable level of precision.

## 4 Design and Write the Questionnaire— Overview

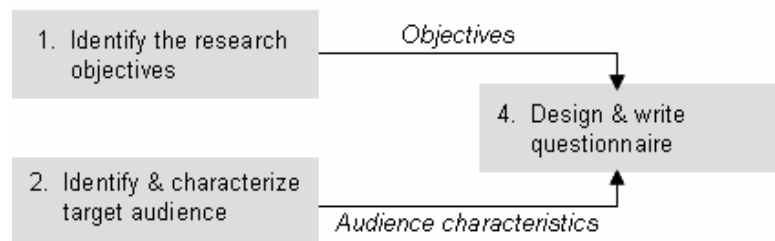


### Introduction

In this section the issues associated with the design and development of the questionnaire instrument are discussed. This stage is divided into substages 4.1 and 4.2, as illustrated in the diagram above. These substages are represented as linear, but there will likely be several iterations between them as the instrument is developed. Each substage is covered in a separate subsection.

### Key inputs

In a way, the questionnaire design and writing started during stages 1 and 2 when the research objectives were defined and the target audience was identified and characterized. The products of these two stages provide important input to how the survey should be designed and written.



---

## 4 Design and Write the Questionnaire—Overview (continued)

### Why objectives are important

The importance of well-defined objectives (stage 1) can not be over-emphasized. A questionnaire that is written without clear objectives will overlook important issues and waste respondents' time by asking useless questions.

The problems of a poorly defined questionnaire continue on to the analysis stage (stage 7). It is difficult to imagine identifying a problem and its cause, let alone its solution, from responses to broad and general questions.

In other words, how can you reach insightful conclusions if you do not know what you were looking for or planning to observe?

If you are finding it difficult to write questions, then perhaps you have not spent enough time defining the objectives of the survey. Go back to that stage again. Questions should follow naturally from well-written objectives.

### Why audience characteristics are important

One of the biggest mistakes novices make is writing a questionnaire for themselves. That is, they use language familiar to themselves as researchers but unintelligible to those who will be responding to the questionnaire items. This is especially the case in the rather immature domain of systems and software engineering, where terms are sometimes ill-defined. Different respondents interpret them differently based on their cultures, experiences, and knowledge.

A questionnaire *must* be written with the target audience in mind. The audience analysis conducted during stage 2 is used to help the researcher develop understandable questionnaire items.

### Designing the survey questionnaire

Questionnaire design addresses the questions listed below.

- How will the survey be mediated (e.g., via paper, email soft copy, Web)?
- How long should the questionnaire be?
- How should the questionnaire be structured and organized?
- What page design and formatting will be most effective?
- What other documents might promote survey effectiveness?

---

## 4 Design and Write the Questionnaire—Overview (continued)

### Writing the questionnaire

There are many things to consider when writing the questionnaire, including

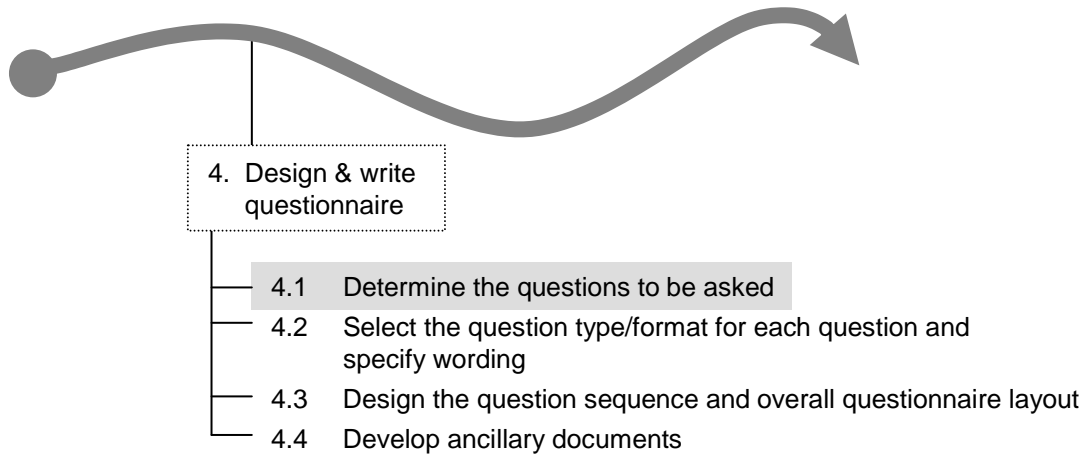
- Do you *really* know what you want to measure?
- Are you writing the questions so they will be understandable to all members of your intended audience?
- How complex are the questions you need to have answered? How difficult will it be for respondents to answer the questions?
- Will respondents be able and willing to provide accurate answers?
- Are you asking the questions in a way that allows the results to be easily tabulated and measured?

### In this section

| Topic   | See page |
|---|----------|
| Determine the questions to be asked                           | 36       |
| Select the question type, format and specific wording         | 40       |
| Design the question sequence and overall questionnaire layout | 54       |
| Develop ancillary documents                                   | 71       |

---

## 4.1 Determine Questions to be Asked



### Introduction

Distinguishing between the questions that the research team need answered (i.e., the *internal* questions) and the questions a respondent is to answer (the *questionnaire items*) is very important. While these two are related, the questions the research team has are usually unsuitable for asking respondents.

In this section we discuss formulating the internal questions based on the objectives identified during stage 1. During this stage, don't be overly concerned about wording and format issues as long as the questions are clear and align to the survey objectives. These questions will then be massaged into appropriate questionnaire items during substage 4.2.

### Types of questions

There are four main types of questions you might want to use in your survey. You can ask people about

- attributes
- attitudes
- beliefs
- behaviors

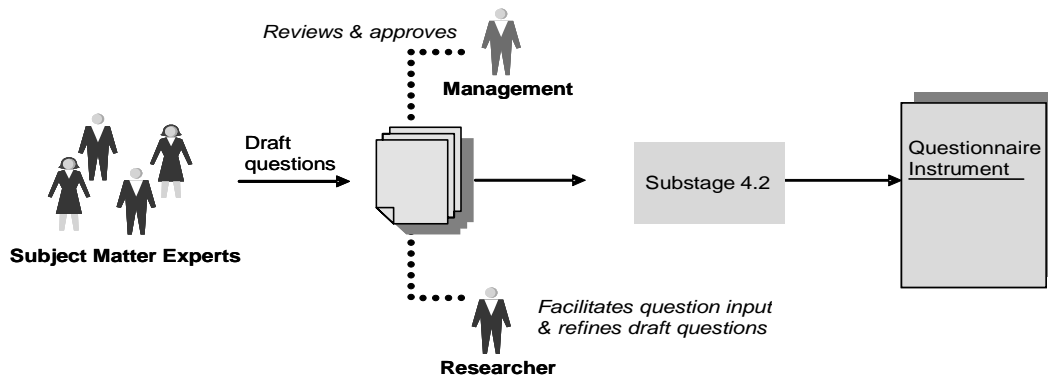
It is important to distinguish among these types of information. Otherwise, attempts to reword questions during substage 4.2 might unwittingly lead not only to a change in wording, but a complete change in the kind of information being elicited.

---

## 4.1 Determine Questions to be Asked (continued)

|  |   |
|--|---|
| <b>Questions about attributes</b>                | <p>Attribute questions typically ask for information about personal or demographic characteristics. Virtually all surveys ask about a number of these attributes. Among the most frequently requested attributes are age, education, organizational size, occupation, years of experience (at a particular occupation), and title or rank (if military).</p> <p>Researchers collect this type of information so they can explore how questions about beliefs, attitudes, and behavior differ for respondents with various attributes.</p>   |
| <b>Questions about attitudes</b>                 | <p>Questions about attitudes differ from questions about beliefs in that they tap into the respondent's personal outlook and orientation, which have been acquired through years of experience. Questions about attitude ask people how they <i>feel</i> about something and require them to indicate whether they have positive or negative feelings about a topic.</p>  |
| <b>Questions about beliefs</b>                   | <p>Beliefs are the respondents' assessments of what they think is true or false. These questions, also referred to as <i>opinion</i> questions, try to determine how people think about a particular subject at a particular time. Belief questions are more focused and specific than attitude questions.</p>  |
| <b>Beliefs vs. attitudes</b>                     | <p>The distinction between belief questions and attitude questions is sometimes a gray area. However, the conceptual distinction is important and can guide the rewording of questions during substage 4.2.</p>   |
| <b>Questions about behaviors</b>                 | <p>Behavior questions ask respondents to describe what they have done in the past or what they are currently doing. They are typically analyzed in terms of</p> <ul style="list-style-type: none"><li>• whether the behavior is present or absent</li><li>• frequency of the behavior</li><li>• degree of behavior performance completion</li></ul> <p>Strictly speaking, behavior questions elicit respondents' <i>beliefs</i> about their behaviors. However, the distinction is useful because people asked to describe their behavior often answer in a different way than they do when asked about their experience of something in a cognitive way.</p> |
| <b>Generating the questions: a team activity</b> | <p>As discussed on page 9, survey work should employ a team approach. If you are the researcher, do yourself a favor and do not assume sole responsibility for generating the internal questions. Your primary task during this substage is to facilitate and elicit these questions from other team members.</p>   |

## 4.1 Determine Questions to be Asked (continued)



### Approach

Below is a team approach you can use to generate internal questions.

| Step | Who                           | Description   |
|------|-------------------------------|---|
| 1    | Researcher                    | Distribute a list of the survey objectives to the team members asking them to formulate their questions of interest against each objective.   |
| 2    | Subject matter experts (SMEs) | For each objective, write questions you believe are relevant. Send these questions to the researcher.   |
| 3    | Researcher                    | Combine questions from stage 2 into a single list. Organize questions for each objective.<br><br><i>If some questions are not mapped to objectives, note this and consider whether the list of objectives needs to be expanded.</i>   |
| 4    | Researcher                    | Organize a meeting to review the submitted draft questions. Send the list to SMEs before the meeting and ask them to be prepared to prioritize the list of questions.   |
| 5    | Team                          | Conduct a review meeting. The researcher facilitates while the team discusses each question. Clarifications are sought where needed. All unusual terminology is defined as a part of this team exercise.<br><br>The team then uses a structured group technique such as multivoting <sup>5</sup> to prioritize the list of questions. |

<sup>5</sup> See the discussion of multivoting in *The Team Handbook* by Peter R. Scholtes. Joiner Associates Inc., 1988, ISBN 0-9622264-0-8.



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## 4.1 Determine Questions to be Asked (continued)

### **Results**

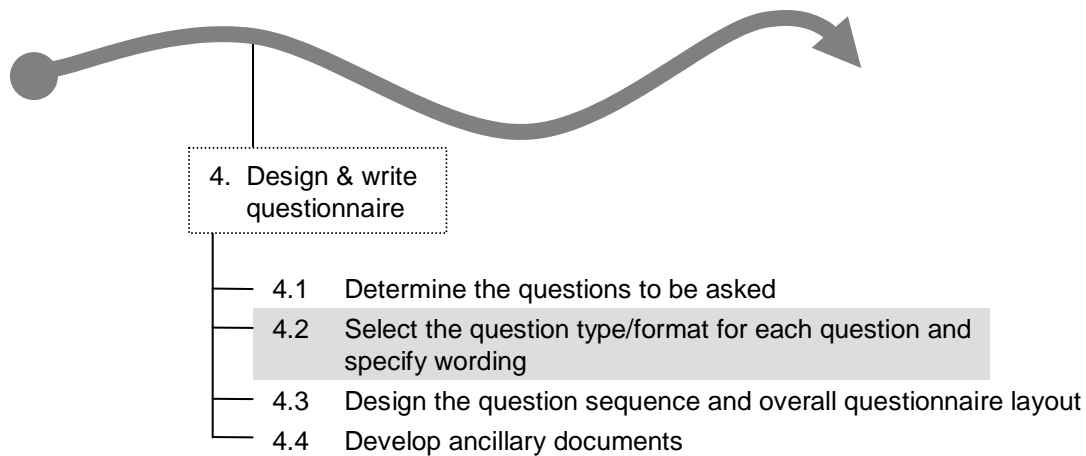
As a result of this substage, the researcher should have a list of prioritized questions that represents the team's thinking about the information to be sought through the survey.

### **Why prioritize questions?**

As part of the above approach, the team prioritized the question list during step 4. Prioritization is typically needed when the team has many questions they want to gather information about. There are practical limitations on the size of a questionnaire instrument. In many cases, difficult decisions must be made to eliminate questions from the questionnaire simply because the length must be such that it can be completed within a reasonable amount of time. This will be discussed next in subsection 4.2.

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## 4.2 Select Question Type, Format, and Specific Wording—Overview



### Introduction

During this substage, the researcher takes the output from substage 4.1 (i.e., the team’s *internal* questions) to develop the actual survey questionnaire. The questions are rewritten so that:

- the responses can be quantitatively analyzed (question structure and format)
- they are understandable to the target audience (question wording)

### Rewriting for response analysis

Questions must be rewritten so that the responses can be quantitatively assessed. This is usually done by transforming open-ended internal questions into closed-ended questions. In many cases, multiple closed-ended questions will be required to address a single open-ended internal question.

*Open-ended questions* are those that ask respondents to express themselves freely without any constraints. These questions have no answer choices from which respondents select their responses. Instead, respondents create their own answers and state them in their own words.

*Closed-ended questions* are questions that provide answer choices. Respondents choose from among the provided answer categories by evaluating each choice and selecting the one that best reflects their situations. Variations of closed-ended questions will be discussed in section 4.2 on page 40.

One disadvantage of using open-ended questions in self-administered questionnaires is the difficulty of constructing meaningful variables for statistical analysis. Therefore, most internal questions (developed during substage 4.1) should be transformed into closed-ended questions.

## 4.2 Select Question Type, Format, and Specific Wording—Overview (continued)

### Rewriting for understandability

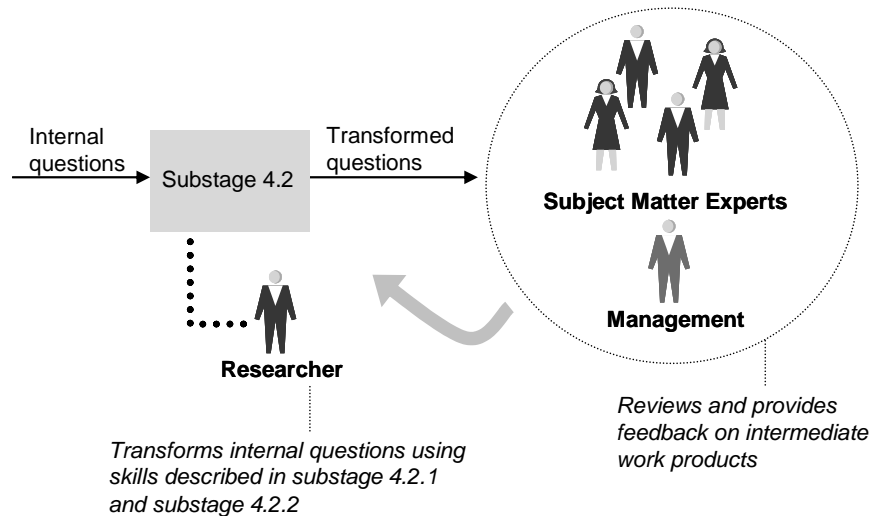
The wording of questions is extremely important. The questions you and your team members ask yourselves are almost always unsuitable for asking respondents directly. Writing questions for themselves is one of the main mistakes novices make when writing questionnaires. The next section addresses this problem in more detail.

### Comment

For the sake of clarity, the discussions about the question structure and format (section 4.2.1) and question wording (section 4.2.2) are discussed separately. However, the constructs presented in each section should not be applied in a linear fashion but considered concurrently as the internal questions are translated into questionnaire items for respondents.

### Reminder

Remember that better survey instruments are the product of a team approach. The researcher should schedule appropriate reviews as the survey questionnaire is being developed.



### In this section

| Section                                | See page |
|--|----------|
| Question structure and response format | 42       |
| Question wording                       | 48       |

---

## 4.2.1 Question Structure and Response Format

### Introduction

A key and powerful property of surveys is their ability to characterize the opinions and behaviors of a population quantitatively in a way that permits uniform interpretation of the population's attributes.

### Question structure & response format: what are they?

*Question structure* refers to the nature of the response behavior that is being asked of the respondent. There are two main categories:

- open-ended questions (sometimes referred to as unstructured questions)
- closed-ended questions (sometimes referred to as structured questions)

In this section we will discuss these two categories and variations of each.

*Response format* refers to how you collect the answer from the respondent. A number of response formats are associated with closed-ended questions. Some of the most commonly used formats will be discussed in this section. The response format for open-ended questions is simply written text.

### Types of question structure

How to structure questions is a major decision for the researcher. The four different question structures discussed in this document are described in the table below.

| Structure                           | Description  |
|-------------------------------------|--|
| Open-ended                          | Respondents create their own answers to the question in their own words. There are no answer choices provided from which they select their responses.  |
| Closed-ended with unordered choices | Respondents choose from among discrete, unordered categories by evaluating each choice and selecting the most appropriate response or responses.   |
| Closed-ended with ordered choices   | Answer choices are provided and the choices are represented as a graduated scale along some single dimension of opinion or behavior. The respondent chooses the most appropriate response from the choices provided. |
| Hybrid                              | Answer choices are provided (as in closed-ended questions), but the respondent can also create a response if the choices are inappropriate (as in an open-ended question).   |

---

## 4.2.1 Question Structure and Response Format (continued)

### **How will you analyze the results?**

The topics covered in this section are related to those discussed in subsection 7.1, “Analyze the Results,” which begins on page 84. They are related because decisions you make (with regard to question structure and format) will impact how you will be able to analyze the resultant response information.

If you are currently in the throes of developing questionnaire items, then you should read the material in subsection 7.1 after you read this section. Both sections together present a more complete view of the issues involved in selecting the proper question structure and format.

### **Open-ended questions lead to qualitative responses**

Open-ended questions lead to narrative, word-based responses.

Qualitative research is a valid and useful tool that can lead to rich and detailed response information about a topic in the original language of the respondent. However, such data cannot be generalized. The information is raw and seldom pre-categorized. Therefore, you must apply very time-consuming methods to interpret, organize, and categorize it.

### **Internal questions from stage 4.1**

Typically, internal questions are expressed as open-ended questions and need to be transformed into closed-ended questions. This allows the population to be characterized quantitatively through descriptive statistics.

In some cases, an internal question will be broad in nature or worded in such a way that more than one question is being asked. When this is the case, the question will need to be transformed into more than one survey question.

### **Can open-ended questions be used in surveys?**

Open-ended questions are most suitable for exploratory, interviewer-led surveys. However, if you intend to include open-ended questions, they should be used sparingly—especially when the sample size is large. If you use them, be prepared to allocate a significant amount of time to organizing, interpreting, filtering, and analyzing the information.<sup>6</sup> Responses to open-ended questions can be difficult or impossible to interpret, and since follow-up questions are not possible in self-administered questionnaires, this presents a problem of validity. Because human judgment is required to filter and interpret the responses, misinterpretation is always a risk.

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<sup>6</sup> See on page 96 of this document for an approach to accomplishing this.

---

## 4.2.1 Question Structure and Response Format (continued)

### **Transforming open-ended questions into closed-ended questions**

Qualitative data consists of words, while quantitative data consists of numbers. While this difference seems to be significant, there is really not much difference between the two. All qualitative data can be coded and transformed into quantitative data.

This is done by transforming open-ended questions into closed-ended questions that lead to responses that can be quantified and generalized across the sample of respondents.

There are two types of closed-ended questions:

- closed-ended questions with ordered responses
- closed-ended questions with unordered responses

### **Closed-ended questions with ordered responses**

Open-ended questions can be translated into closed-ended questions with ordered responses through the process of scaling.<sup>7</sup>

Scaling is the assignment of objects to numbers according to a rule [Stevens 59]. In survey research, the objects are text statements—especially statements of opinion, attitude, or belief.

There are different types of response scales, including

- dichotomous response scales (such as yes/no, agree/disagree)
- ordinal response scales (e.g., poor, fair, neutral, good, very good)

For the latter, each choice offered for a response represents a gradation of a single dimension of some topic. This type of question is well-suited for determining the intensity of a belief or feeling and the frequency of a behavior.

Respondents must identify the response that places them at the most appropriate point on a scale implied by the answer choices.

Ordinal response scales as described above are commonly referred to as “Likert scales” due to their association with the Likert scaling method [Likert 32].

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<sup>7</sup> There are three different types of uni-dimensional scaling methods including Thurstone, Guttman, and Likert scaling. A discussion of these is beyond the scope of this document. However, Trochim provides a cogent discussion of each method [Trochim 01].

---

## 4.2.1 Question Structure and Response Format (continued)

### Example: Likert response scale

Below is one example of an ordinal response scale.

| Response          | Scale |
|-------------------|-------|
| Strongly disagree | 1     |
| Disagree          | 2     |
| Undecided         | 3     |
| Agree             | 4     |
| Strongly Agree    | 5     |

Likert scales can have different ranges, for example from 0-4, 1-7, 1-9, and so on. In some cases, the scale is odd-numbered with the middle value labeled as “undecided” or “neutral.” When there is a possibility that a respondent cannot answer the question, then it is appropriate to include a “Don’t Know” or “Doesn’t Apply” response that is assigned the scale value of zero.

### Other examples of Likert scales

See Appendix D beginning on page 123 for examples of popular Likert scales.

### Examples: Questions using Likert response scale

Here are some examples of questions that employ a Likert response scale.

|  | Strongly Agree           | Agree                    | Disagree                 | Strongly Disagree        | N/A                      |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Technical reviewers use proposal evaluation criteria during solicitation activities. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Notice that although numerical values are applied for each response, the respondent does not need to be aware of this assignment when completing the questionnaire.

### Closed-ended questions with unordered responses

Closed-ended questions with unordered responses differ from those with ordered responses. Ordered responses do not limit the respondents to choosing from a gradation of a one-dimensional concept. These types of questions provide unordered answer choices that respondents must evaluate in relation to each other.

These types of questions may also permit the respondent to answer by checking all responses that apply.

---

## 4.2.1 Question Structure and Response Format (continued)

### Example

Below is an example of a closed-ended question with unordered responses.

Which of the following have you spent the most time doing during the past work week?

- Talking to customers on the phone
- Attending meetings
- Working on my computer
- None of the above

### Hybrid questions

A *hybrid question* can be thought of as a partially closed-ended question that allows the respondents to write their own answers if the options provided are unsuitable. This format does not force respondents into choosing answers that do not fit.

Hybrid questions should always be used when you suspect that some response options have been overlooked. They are most appropriate for closed-ended questions with unordered responses (rather than with ordered responses).

### Example: hybrid question

Below is an example of a hybrid question.

Which of the following have you spent the most time doing during the past work week?

- Talking to customers on the phone
- Attending meetings
- Working on my computer
- None of the above
- Other [Please specify in the space provided]

\_\_\_\_\_

Note that if “other” is checked, respondents create their own responses to the question.



---

## 4.2.1 Question Structure and Response Format (continued)

### **Section summary**

In this section, issues involving question structure and response format were discussed. Internal questions (those posed by you or the subject matter experts on your research team) are typically open-ended questions that are unsuitable for a survey instrument.

Also discussed were ways to restate these open-ended questions in closed-ended form to facilitate the interpretation and analysis of the information received. The next section focuses on the word content of the questions.

For large-sample surveys, using open-ended questions might provide a lot of interesting information, but the task of interpreting and organizing the response information is daunting to say the least. It is very difficult to transform such information into quantitative data that can inform decision-makers. For this reason, open-ended questions should be used sparingly in survey instruments.

---

## 4.2.2 Question Wording

### Introduction

Earlier in this document, the concept of *construct validity* was introduced as an important concern of the research team (see page 12). Construct validity addresses the issue of whether a survey is measuring what it intends to measure. In this section, operational mitigations used to improve construct validity are described.

There are three conditions for ensuring valid responses to survey questions. The respondents must

1. understand the question
2. be capable of providing the information requested
3. be willing to provide the information requested

While all three are needed, take particular care in wording each question so that the respondents understand it. The wrong choice of words can create any number of problems. If the question is ambiguous or confusing, the response will be worse than valueless—it will be misleading.

Questions must be carefully designed in language that is readily understandable by the respondents.

### The problem with simple guidelines for wording

While no one will argue about the importance of choosing the right words, providing satisfactory guidelines for wording questions is not without challenges. The problem is that the rules, admonitions, and principles for how to word questions, while generally good, often conflict with one another. Consider this list of question-wording admonitions from texts on questionnaire design:

- Do not be vague.
- Use simple words.
- Keep it short.
- Be specific.
- Avoid bias.
- Do not be too specific.
- Avoid hypothetical questions.

The problem is that these guidelines often get in one another's way. For example, "use simple words" is good advice, but it frequently interferes with advice to "keep it short." The advice, "do not be vague" can lead to questions that are "too specific."

---

## 4.2.2 Question Wording (continued)

### Questions have a context

The reason that seemingly good advice may turn out to be bad advice is that questions are not written in the abstract. Questions are written for

1. a particular target audience (or population)
2. a particular purpose
3. placement next to other questions in the questionnaire

Words that are too difficult for use with some audiences might be perfectly acceptable for others. A question that is vague may satisfy the objectives of an exploratory study, but not the objectives of an analytic study. A question that may not make sense by itself may be very clear when it is asked with ones that directly precede it.

This is why the audience analysis (a product of stage 2) is such an important resource during this substage.

### Using the audience analysis

Questions must be worded for the population of individuals characterized in the audience analysis. This means that the researcher must take into consideration the education, vocabulary, culture, and experiences of the respondents.

### Some common wording problems

In his book titled *Mail and Telephone Surveys: The Total Design Method*, Dillman recognized that simple admonitions about wording, no matter how well intended, cannot be considered absolute principles that must be adhered to without exception. Instead, he organized a list of common wording problems as a series of questions that can and should be asked about each item a researcher considers for inclusion in a survey [Dillman 78].

They are:

- Will the words be uniformly understood?
- Do the questions use unconventional terminology, phrases, or abbreviations?
- Are the questions too cryptic, vague, or precise?
- Is the question biased?
- Is the question objectionable?
- Is the question too demanding?
- Is it a compound question?
- Does the question include a double negative?
- Are the answer choices mutually exclusive and exhaustive?
- Have you assumed too much about respondent knowledge or behavior?
- Is the question technically accurate?

---

## 4.2.2 Question Wording (continued)

### **Wording uniformly understood?**

If you want the question to mean the same thing to all respondents, keep the wording as clear and unambiguous as possible. Do not use words that are needlessly complex. A thesaurus is an indispensable tool for finding replacement words for those that can be simplified.

Piloting the survey with representatives of the target audience is very important because it helps you find the commonly shared vocabulary of the target audience. Piloting is discussed in stage 5 of the survey process.

### **Unconventional terminology and abbreviations?**

Be careful to avoid technical terminology that might not be universally understood by the target audience. This is a common mistake made by subject matter experts fielding a questionnaire for systems and software engineering practitioners. While certain terms may be defined a certain way in the technical literature, in practice the same words can have very different interpretations and meanings. For example, the following terms are interpreted differently across the community:

- software (or systems) architecture
- integrated product team
- Six Sigma
- process capability
- requirements engineering and/or management

Avoid using abbreviations unless you are confident that the abbreviation is universally understood by your target audience.

### **Vague or too precise?**

People interpret vague terminology in many different ways. Therefore, their responses will be equally varied. Varied replies due to vague wording render the responses meaningless. (Don't forget that in a self-administered questionnaire, there is no way to test understanding or probe further with follow-up questions.)

When evaluating vagueness of wording and the overall meaning of questions, it is important not to isolate the questions from others in the questionnaire. In a series of questions, a term that would otherwise be vague might be absolutely clear in the context of the other accompanying questions.

On the other hand, the desire to avoid vagueness can sometimes result in a question being so precise that respondents have difficulty answering it. For example, it may be too much to ask respondents how many times they performed an activity during the last year. A better way to ask the question is to list number ranges from which respondents can choose without having to be overly precise.

---

## 4.2.2 Question Wording (continued)

### Is the question biased?

Bias must be avoided in questions. This means that questions should be phrased carefully to avoid suggesting that certain answers are more acceptable than others.

Moser and Kalton have defined “bias” as occurring if the content, structure, or wording of a question leads respondents in the direction of a certain answer. This can occur with leading questions that include a component of expectation within them [Moser 89].

In his excellent primer, *The Art of Asking Questions*, Payne illustrated the influence of leading questions in a story of a snack-bar waiter who increased spectacularly the sale of eggs in milk shakes. He asked customers not whether they wanted an egg or not, but whether, in fact, they wanted one or two (the choice of zero eggs was not included) [Payne 80]. While this is a fine sales technique, it would, of course, be unsuitable for scientific research.

### Is the question objectionable?

Respondents might find a question objectionable for a number of reasons. For example,

- they might consider the question too personal and feel that no one has the right to that information
- they might find the question incriminating if they are being asked to expose behavior that violates their organization’s policies.<sup>8</sup>

The researcher needs to be careful since it only takes a few objectionable questions to make the respondent refuse to answer any part of the questionnaire. The researcher must always ensure that information will not be disclosed in a way that allows it be attributed to any single respondent.

### Is the question too demanding?

In some cases, technical researchers will propose questions that require a great deal of mental processing on the part of the respondent. In these cases, the patience of even the most enthusiastic survey respondent may be challenged. The lack of an interviewer who can explain how certain questions are to be answered makes it essential that questions sometimes used in face-to-face interviews be modified or eliminated from self-administered questionnaires.

There are two issues here: (1) telescoping, and (2) forgetting. For many, memory has a telescoping effect, where two months seem like one, and a year ago seems like six months. It’s unreasonable to think that individuals can call up detailed accounts of behaviors that have occurred a week ago, let alone during the last year.

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*Continued on next page*

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<sup>8</sup> Even though the source of survey responses are anonymous, many people may not want to take the risk of being identified as the author of a given response.

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## 4.2.2 Question Wording (continued)

### Is the question too demanding? (continued)

Although there is no doubt that accurate answers to the questions would be of great value, it is doubtful whether people are willing or capable of providing them—especially in cases where the respondent is a busy individual with many responsibilities. These types of questions must be avoided.

### Are you using a compound question?

Compound questions are sometimes referred to as double-barreled questions. They are separate questions that have been combined into one, yet the respondent is asked to provide a single answer. In these cases, you cannot be sure which part of the question the respondent is really answering and the response cannot be interpreted correctly.

Never ask two questions in one questionnaire item.

### Double-negatives?

Never use double-negatives in survey questions. These typically occur when yes/no or agree/disagree are provided as response options.

Here is an example of a double negative:

Should the project manager not be responsible for quality standards within his team?

- Yes
- No

Here is a suggested revision to avoid the double-negative:

In your organization, who is responsible for quality standards?

- Program manager
- Project manager
- Staff members
- Don't know

---

## 4.2.2 Question Wording (continued)

### Choices mutually exclusive and exhaustive?

Be careful to avoid providing response options that are not mutually exclusive. For example, consider the following question and response set.

How many years of systems engineering experience do you have?

- 0-3
- 3-5
- 5-10
- > 10

Note that individuals who have three years experience could choose the first or second response. Those with five years of experience could choose the second or third response.

### Have you assumed too much about the respondent?

In almost all questions, the researcher assumes the respondent possesses a certain amount of knowledge. However, the problem of assuming too much knowledge in surveys is prevalent—especially in technical domains.

To avoid this problem, always consider including an option such as “Don’t Know” as part of the response set. Another way to avoid the problem is to include a response option such as “It depends,” coupled with a prompt to the responder to explain their selection of that option.

False assumptions might also be made about respondent behavior. Consider including the response “None of the above” as part of the response set. Or include a partially closed-ended response category that includes “Other” and have respondents specify their definition of “Other.”

### Is the question technically accurate?

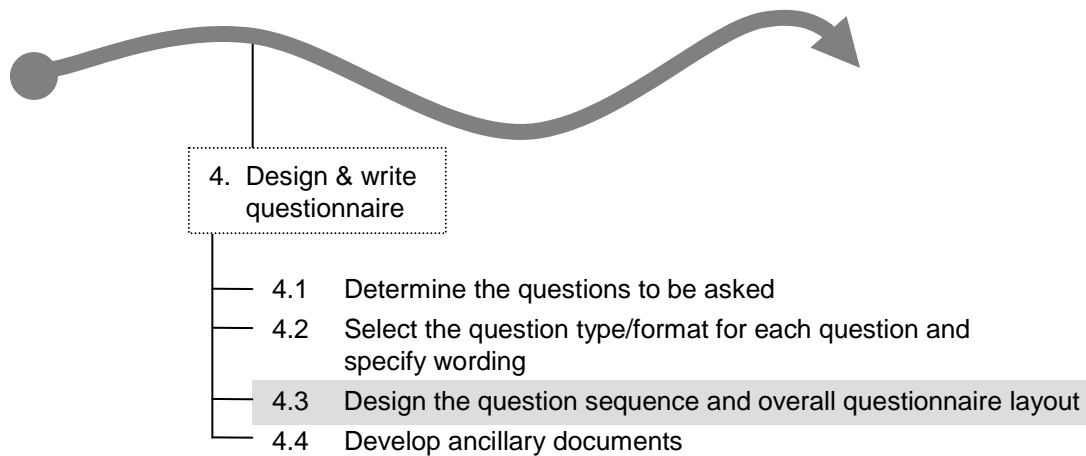
In some cases, information is provided as part of the question. Therefore, it is important that this information is technically accurate, leaving no doubt of the researcher’s understanding of the topic being investigated.

### Section summary

In this section, we have reviewed a number of points that the researcher should ask of every question in their survey. If there is a negative answer to any of these questions, then the question-writing task is incomplete.

---

## 4.3 Design Question Sequence and Overall Questionnaire Layout



### Introduction

At this point in the survey development process, you should have a list of questions that you believe address the research objectives of the survey. But there is still more work to do before your questionnaire is complete and ready to be tested and distributed to your target audience.

To complete the survey questionnaire, you will need to consider the

- length of the questionnaire
- organization and sequencing of questions
- instructions and questionnaire section introductions
- page layout options, including
  - hardcopy questionnaires for mailing
  - Web-hosted questionnaire
  - email
  - other, such as commercial survey software

### In this section

| Section   | See page |
|---|----------|
| Determining the length of your questionnaire        | 55       |
| Organizing and sequencing your questions            | 57       |
| Instructions and transition paragraphs              | 58       |
| Questionnaire page layout considerations—paper form | 60       |
| Web-based questionnaires                            | 63       |



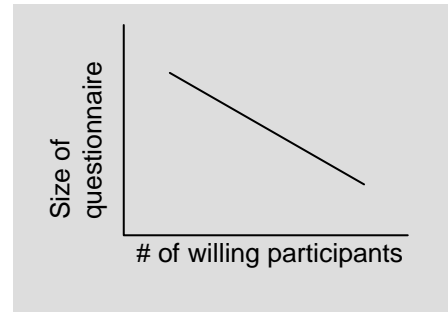
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## 4.3.1 Determining the Length of Your Questionnaire

### Introduction

Many researchers make the mistake of asking too many questions. This often arises from an incomplete analysis of how to meet the survey objectives. Questionnaire length is one of the most frequent reasons that potential survey respondents give when refusing to participate in a survey [Burchell 92]. Your greatest enemy in survey research may well be poor response rate.

Determining the appropriate length of your questionnaire is like walking a tightrope. On the one hand, you want to make the most of this opportunity to ask your target audience questions. On the other hand, if your questionnaire is too long, potential respondents will view it as something they do not have the time to complete and will not participate. If you have a poor response rate, then your research study will be weak.



As the primary researcher, you want to do everything within your power to promote a high response rate from your audience. The longer the questionnaire, the less likely that individuals will be willing to participate in it.

### Has the size of your questionnaire grown?

In the paragraph labeled “Why prioritize questions?” on page 39, you are encouraged to begin considering size constraints for the questionnaire. Now, as a result of transforming internal questions into suitable questions for respondents (during substage 4.2), you may find that the number of questions has increased dramatically—perhaps you now have double or even triple the number of internal questions you had at the start. This occurs because a single internal open-ended question can require several closed-ended questions to address the intent of the original internal question.

You must now take a hard look at what you have and make difficult decisions to pare down the number of questions in your survey.

### How long can your questionnaire be?

Numerous studies have shown the significant effect of questionnaire length on response rates. Each additional question can reduce response rate by 0.5%, and each additional page by 5% [Heberlein 78].

There is a significant decrease in response rates for questionnaires longer than four pages [Yammarino 91].

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### 4.3.1 Determining the Length of Your Questionnaire

#### **Effect on data quality**

Questionnaire length is also believed to affect data quality. As the time-to-complete duration lengthens, respondents can become tired, annoyed, bored, or distracted by external factors. This can decrease the degree of effort and thought that respondents invest in answering questions [James 90]. Other findings on the effect of questionnaire length on data quality generally suggest overly long questionnaires have a negative influence on data quality [Burchell 92, Helgeson 94, Herzog 81].

#### **Exceptions to the rule?**

If you believe your questionnaire is bordering on being too lengthy, there are some tactics you can employ to promote participation.

Perception of length can be moderated by other characteristics of the survey or survey process. For example, if respondents are interested in the topic of the survey they might be willing to go the extra mile to complete a lengthy questionnaire. Promising to inform the respondents about the survey's results can sometimes improve the response rate. Other incentives (e.g., financial, prizes, appealing to philanthropy) can also mitigate the negative impact of questionnaire length on response rate.

However, keep in mind that incentives are typically employed to boost participation even when the questionnaire is a reasonable length.

#### **How to decide which questions to include**

If your questionnaire is too long and you need to reduce the length, review each of your questions carefully with respect to the objectives that were developed during stage 1 of this process. For each question, ask yourself what you will do with the information. If you cannot give yourself a satisfactory answer, leave it out. Avoid the temptation to add a few more questions just because you are doing a survey anyway. It may help to place your questions into three groups:

1. must know
2. useful to know
3. nice to know

Discard group 3 unless groups 1 and 2 are very short.

The best way to categorize your questions is to invite your subject matter experts and the management that sponsored the survey development project to participate. You can use a structured group decision-making tool such as multi-voting<sup>9</sup> to select the highest priority questions for your survey.

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<sup>9</sup> Scholtes describes the multi-voting technique [Scholtes 88].

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## 4.3.2 Organizing and Sequencing Your Questions

### Introduction

This section describes the way questions in your survey questionnaire should be arranged and organized. Sections of your questionnaire also will need to be introduced appropriately with explanatory information and clear and concise instructions for the respondent.

### Question categories

The table below describes the three basic categories in a questionnaire.

| Category    | Description  |
|-------------|--|
| Demographic | These are questions about respondents' characteristics and circumstances. They are often used to compare answers to substantive questions between respondents with different characteristics (e.g., managers vs. staff, men vs. women, experienced vs. inexperienced). |
| Substantive | These are questions that are the substance of the survey—the ones that address the survey objectives.  |
| Filter      | In some surveys, there are questions that do not apply to all respondents. Any question whose response determines whether another question is to be responded to is a filter question.   |

### Grouping and organizing questions

Don't skip around from topic to topic. Just as in writing a paper, prepare an outline and group your questions according to topic or subject matter. Write transitional statements between sections or changes in subject matter.

Demographic questions are fact-based questions, as opposed to substantive questions, which are typically opinion based. Demographic questions, which are typically easier to answer, are usually asked at the beginning of the questionnaire. Asking the demographic questions gets respondents engaged in the questionnaire and warmed up before answering more challenging and reflective questions about their opinions.

The substantive questions should follow. If your substantive questions include any open-ended questions, these should be positioned towards the end of the questionnaire since it is usually easier to respond to closed-ended questions.

### Sequencing your questions

Providing the proper order is not a trivial issue. The location of a question must be considered in light of how it will affect questions that follow it. Questions should flow in a logical order.

---

### 4.3.3 Instructions and Transition Paragraphs

|                             |  |
|-----------------------------|--|
| <b>Introduction</b>         | <p>Thus far, you have grouped the questions by subject matter and carefully sequenced them. Of course, this was not a one-shot effort and probably required several iterations before the organization was correct.</p> <p>In this section the importance of non-question information critical to obtaining quality information is discussed.</p>  |
| <b>Non-question text</b>    | <p>In addition to the questions, you will need to include other non-question information in your questionnaire, including</p> <ul style="list-style-type: none"><li>• survey title</li><li>• instructions</li><li>• transition paragraphs</li><li>• definitions</li></ul>  |
| <b>Survey title</b>         | <p>A descriptive survey title should appear at the top of the questionnaire. You should also consider including the title as part of the header or footer of each page of the questionnaire (if it is a paper or emailed form) or at the top or bottom of the screen (if it is a Web-based form).</p>  |
| <b>Writing instructions</b> | <p>For self-administered questionnaires, you must ensure that the respondents understand how to answer each question. Unlike face-to-face interview surveys or telephone surveys, self-administered surveys are self-contained and respondents do not have the opportunity to ask questions about how to complete the survey questionnaire.</p> <p>The method for answering each question must be spelled out. Tell respondents exactly how to answer. For example,</p> <ul style="list-style-type: none"><li>• Does the question require a single answer only, or should they select all answers that apply, or should they select a specific number of alternatives that have been provided by the questionnaire item?</li><li>• Should a question be answered by checking a box? Or by choosing from a pull-down menu? Or by writing a brief answer?</li></ul> <p>Instructions must be worded clearly and appear next to the questions involved.</p> <p>Never assume that respondents will understand what they should do unless you specifically instruct them how to do it.</p> |

---

### 4.3.3 Instructions and Transition Paragraphs (continued)

#### **Writing transition paragraphs**

If your questionnaire includes multiple sections, provide brief transitional paragraphs to orient respondents to what is coming up.

An example of a transitional paragraph that prepares a respondent for answering a group of questionnaire items is presented below.

#### Example

*The following items ask about the types of training you have received in relation to your existing position and responsibilities.*

#### **Writing definitions**

You should always try to use words that are easily understood by your audience and do not require definition. However, in the domains of systems and software engineering, there are many terms that defy universal definition. For these cases, you *must* let the respondent know how to interpret them.

There are various ways to accomplish this. If there are few terms in your questionnaire that require definitions, it is fine to provide the definition as part of the question. But, if there are many terms you suspect would not be uniformly interpreted, you might want to provide a glossary section as part of your questionnaire. Each term in the glossary could be italicized or underlined within a question to indicate that it appears in the glossary.

If you are mediating your questionnaire using the Web, then consider using hypertext so that the respondent can click on a term to immediately see the operational definition as you intend it.

---

## 4.3.4 Questionnaire Page Layout Considerations—Paper Form

### Introduction

This section provides page layout guidance for questionnaires mailed to respondents in paper form or sent as attachments in email.

The design and print quality of your questionnaire will convey a certain meaning to respondents. Forms that look attractive impress upon the recipient that care has been taken in their development, and an effective page layout also makes your questionnaire easier to understand. Your questionnaire should be easy to read and complete.

### What if you are planning to use a Web-based questionnaire?

Although you may be planning to develop a Web-based version of your questionnaire for respondents to complete, you should also prepare a paper form for those individuals who have difficulty using the Internet form.

Due to differences in Web browser types and versions, some of your intended respondents may request a paper copy, and you need to be prepared by having one available.

### Guidelines

“Right and wrong do not exist in graphic design. There is only effective and non-effective communication” [Bilak 95].

Use the following heuristics to guide the layout of your questionnaire:

- Keep your answer choices in a straight, neat column. (See the example after this list of guidelines.)
- Nothing improves a bad layout faster than a good dose of nothingness. White space is not wasted space. It provides visual breathing room for the eye. Add white space to make a page less cramped, confusing, or overwhelming. Do not cram too many questions on a single page. Proper spacing makes it easier to read and process the information. (See the example after this list of guidelines.)
- Do not split a question across two pages. Each question, and its possible responses, if provided, should appear on the same page. If the entire question does not fit on a page, then change the order of questions (if possible), or simply leave a blank area at the bottom of the page.
- Use the right-hand edge of the paper for answer choices. (Eye tracking studies show that this is the best place to position the answer choices.) Using the right edge is also easiest for data entry
- Do not use too many different types of fonts, font sizes, or font colors. Doing so is distracting to the reader.

---

*Continued on next page*

#### 4.3.4 Questionnaire Page Layout Considerations—Paper Form (continued)

##### Guidelines (continued)

- Use bold-face, italics, and different font colors sparingly. Develop conventions for using font changes in your questionnaire and be consistent.
- Graphics should be used only if they serve a purpose.
- Do not cross-reference information in a different part of the questionnaire. Place information the respondent needs where they need it.
- To help individuals with poor eyesight:
  - Always use a font size of at least 10 points.
  - Choose strongly contrasting paper and font color.
- Never use ALL CAPS. Typing in ALL CAPS is considered shouting and is frowned on in most cases.
- Include page numbers.
- Include the survey title as part of the header or footer on all pages except the title page.

##### Example: alignment of answer choices

The example below contrasts poor alignment with the appropriate alignment of answer choices.

##### **Bad – Poor alignment of answer choices:**

- |    |   |
|----|---|
| 1. | The acquisition project team ensures there is no loss in continuity of support to the software products during transition from the development contractor to the software support organization.<br><input type="checkbox"/> Agree <input type="checkbox"/> Unsure <input type="checkbox"/> Disagree |
| 2  | Configuration management of the software products is maintained throughout the transition. . <input type="checkbox"/><br>Agree <input type="checkbox"/> Unsure <input type="checkbox"/> Disagree  |
| 3  | The strategy for transition into maintenance is documented, communicated, and agreed to by all parties early in the acquisition. <input type="checkbox"/> Agree <input type="checkbox"/> Unsure <input type="checkbox"/> Disagree   |

##### **Good – Appropriate alignment of answer choices:**

|    |   | Agree                    | Unsure                   | Disagree                 |
|----|---|--------------------------|--------------------------|--------------------------|
| 1. | The acquisition project team ensures there is no loss in continuity of support to the software products during transition from the development contractor to the software support organization. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2  | Configuration management of the software products is maintained throughout the transition.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3  | The strategy for transition into maintenance is documented, communicated, and agreed to by all parties early in the acquisition.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

---

#### 4.3.4 Questionnaire Page Layout Considerations—Paper Form (continued)

**Example: use of white space**

The example below contrasts the lack of appropriate white space to the effective use of white space. Note that appropriate white space makes the questions easier to read and respond to.

**Bad – Lack of appropriate white space:**

|  | Agree                    | Unsure                   | Disagree                 |
|--|--------------------------|--------------------------|--------------------------|
| 1. The acquisition project team ensures there is no loss in continuity of support to the software products during transition from the development contractor to the software support organization. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Configuration management of the software products is maintained throughout the transition.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. The strategy for transition into maintenance is documented, communicated, and agreed to by all parties early in the acquisition.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**Good – Appropriate use of white space:**

|  | Agree                    | Unsure                   | Disagree                 |
|--|--------------------------|--------------------------|--------------------------|
| 1. The acquisition project team ensures there is no loss in continuity of support to the software products during transition from the development contractor to the software support organization. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Configuration management of the software products is maintained throughout the transition.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. The strategy for transition into maintenance is documented, communicated, and agreed to by all parties early in the acquisition.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |



---

## 4.3.5 Web-Based Questionnaires

|  |  |
|--|--|
| <b>Introduction</b>                                  | <p>There has been a strong upward trend in the use of Internet-based surveys. Surveys mediated through the World Wide Web are popular for a number of reasons that will be discussed in this section.</p>  |
| <b>Skills needed</b>                                 | <p>The guidelines for developing paper-based questionnaires also apply to Web-based questionnaires. However, there are additional issues that you must consider when implementing Web-based questionnaires.</p> <p>Unlike paper-based questionnaires, the design and development of Web-based questionnaires require Web page design skills and computer programming expertise.</p>  |
| <b>Availability of Web-based survey products</b>     | <p>There are many companies that provide products and services for implementing Web-based surveys. A list of these companies can be obtained by searching the Web.</p> <p>This section provides some high-level guidance for the development of a Web-based survey application. You might also want to consider attending training if you are planning to develop your own. Service-providers that offer training can be located through a Web search.</p> <p>This section does not attempt to address computer language issues involved in developing a Web-based survey application. However, various design criteria and issues are discussed that can be used to evaluate alternative service providers.</p> |
| <b>Impact of large-volume traffic on your system</b> | <p>If you plan to conduct an extensive survey with a large sample, you need to understand the network performance impact of having large numbers of respondents simultaneously log on to the server hosting the Web-based questionnaire.</p> <p>You will need to work with your network system administrator to ensure that the system can withstand the volume of traffic that can result from simultaneous access to the Web-based questionnaire. The impact on network connectivity and on database transaction performance should be understood before a Web-based implementation is chosen for mediating your survey research.</p>  |

---

### 4.3.5 Web-Based Questionnaires (continued)

#### Advantages of Web-based surveys

Web-based surveys possess a number of advantages over mailed paper surveys. These include

- a faster response rate
- the ease of sending reminders to survey participants
- the ease of processing data
- dynamic error-checking capability
- the ability to make complex skip pattern questions easier to follow (see previous mention of filter questions on page 57)
- the use of pop-up definitions and instructions for selected questions
- the use of drop-down boxes

#### Providing access to the questionnaire

To protect the validity of a Web-based survey, access *must* be carefully controlled. This is done to

- prevent unauthorized individuals from participating in the survey
- prevent duplicate submissions by the same respondent
- ensure that respondents' privacy, and their perception of privacy, is protected

Access can be restricted by emailing candidate respondents a unique personal identification number (PIN) or a username/password combination to access the Web-based survey. (“Candidate respondents” are those who have been selected as a result of the sampling plan in stage 3 of this process.)

#### Screen presentation styles

Unlike paper-based questionnaires, Web-based questionnaires appear on a computer screen and should be designed accordingly.

There are two primary methods for presenting information to the respondent:

- questionnaires that provide questions screen-by-screen
- questionnaires that allow scrolling

With the screen-by-screen method, respondent must complete a question (or a few questions) before proceeding to the next screen of questions. Scrollable questionnaires allow vertical scrolling, giving the respondent the entire view of the questionnaire or a section of the questionnaire.

Of course, some combination of the two methods can be implemented, if appropriate. Also, questionnaires can differ greatly within these categories because of variations in layout and methods of navigation.

Research has concluded that a generic design format for all Web-based questionnaires is not as suitable as designing each questionnaire to reflect its purpose. Some designs are more suitable for certain audiences, purposes, or types of questions than others [Couper 00].

---

### 4.3.5 Web-Based Questionnaires (continued)

#### **Graphic design issues**

Web-based design may require more thought when it comes to color schemes, font choices, and layout options. Take advantage of the wealth of information available in graphic design theory. Poor choice of color design or small or inconsistent fonts can lead to respondents aborting the survey.

If you belong to an organization that maintains a graphic design staff, then by all means obtain their support and feedback.

#### **The welcome screen**

Begin your questionnaire with a welcome screen that is clear, concise, and provides general instructions. This screen should display many of the information items included in cover letters used for paper-based questionnaires. (See page 72 for content guidelines for a survey cover letter.)

#### **Navigation**

If your questionnaire contains multiple sections, you need to clearly indicate that additional items must be accessed either by scrolling or by clicking on a control button to move to the next screen.

Respondents should be able to navigate easily through the questionnaire—streamlining forward through the questionnaire and backtracking so answers can be changed (unless the effects of the question order are a concern of the research team).

#### **Choice of response format**

There are a variety of response formats that are available with Web-based surveys, including

- radio buttons
- check boxes
- drop-down boxes
- text input
- text area

These are explained in further detail in upcoming paragraphs.

---

### 4.3.5 Web-Based Questionnaires (continued)

#### Radio buttons

Radio buttons are appropriate for questions that require a “select only one” choice from mutually exclusive items.

##### Example: Radio buttons

Q10. What title best describes your position in your organization?

- Program Director
- Project Manager
- Engineer
- Clerical
- Other

#### Check boxes

Check boxes are appropriate for “check all that apply” questions.

##### Example: Check boxes

Q5. Which of the following training courses did you take during the year 2004?

Check all that apply.

- Project Management Basics
- Communication Skills
- Performance Measurement
- Intro to Negotiation
- Acquisition Management

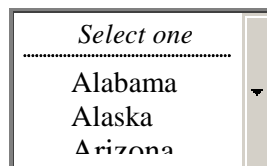
#### Drop-down boxes

Drop-down boxes are used to select one item from a list of options. For long lists, allow type-ahead look-up since it prevents tedious scrolling.

Provide a visual cue for the task in the drop-down box. For example, “Please select one.”

##### Example: Drop-down boxes

Q3. What state is your company located in?



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### 4.3.5 Web-Based Questionnaires (continued)

#### Text boxes

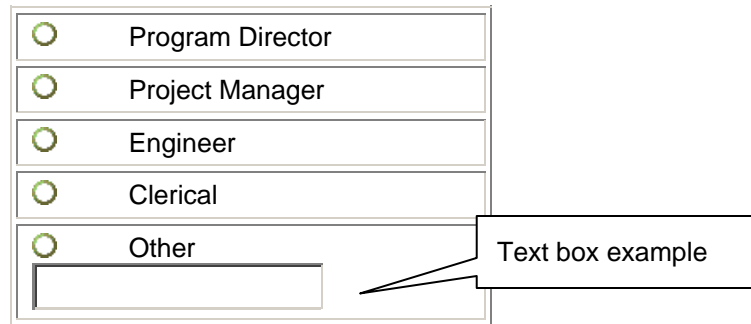
The text box allows respondents to type in an answer using their own words. Text boxes are used

- when a very brief response to an open-ended question is presented
- as part of a partially closed question when the provided response options are not appropriate for the respondent. If “other” is chosen, respondents can type in their own responses.

When using text boxes, ensure that the size of the box will accommodate the amount of text that is typed. Also, provide clear instructions for input guidance. For example, if a calendar date is required, provide guidance for the required format, such as MM/DD/YYYY.

#### Example: Text box

Q10. Please indicate the role that best describes your position. If you select “Other” type your own position description.



The image shows a form with five radio button options: Program Director, Project Manager, Engineer, Clerical, and Other. The 'Other' option is selected. Below the 'Other' option is a text box for entering a custom position description. A callout box labeled 'Text box example' points to this text box.

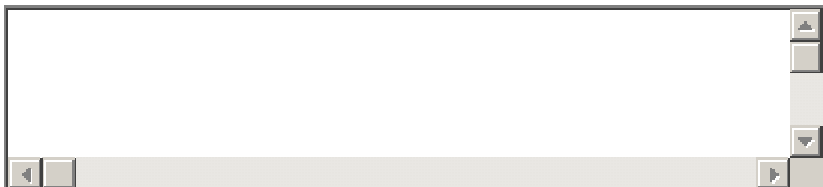
#### Text areas

A text area allows a response to open-ended questions. For reasons listed on page 40, open-ended questions should be used sparingly.

Text areas are scrollable, allowing the respondent to reply with as many words as the questionnaire designer allows.

#### Example: Text area

Q25. Overall, what are the one or two most difficult problems that your project has faced in conducting successful acquisition of software-intensive systems? (Please describe in your own words.)



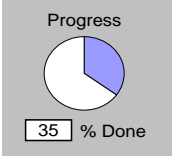
The image shows a large, empty text area with a scrollable interface, including vertical and horizontal scrollbars, intended for a long-form answer.

---

### 4.3.5 Web-Based Questionnaires (continued)

**Progress indicator** Research has shown that respondents like to see a progress indicator so they can tell how many questions remain in the questionnaire. [Lozar 02]. Couper reported that a progress indicator may motivate respondents to complete a questionnaire. However, this positive effect could be counteracted if the download time increases due to the addition of a graphic process indicator. [Couper 01]

**Example: progress indicator** An example of a progress indicator adapted from Couper is shown below [Couper 01].



Q5. Which of the following training courses did you take during the year 2004? Check all that apply.

|  |  |
|--|--|
| <input type="checkbox"/> Project Management Basics | <input type="checkbox"/> Introduction to Negotiation |
| <input type="checkbox"/> Communication Skills      | <input type="checkbox"/> Acquisition Management      |
| <input type="checkbox"/> Performance Measurement   | <input type="checkbox"/> Designing Web Pages         |

**Other design characteristics**

As with paper-based questionnaires, page layout is important and can have a positive or negative effect on respondent participation.

The lack of appropriate spacing (that is, empty space), crowded horizontal design, and unconventional layouts can make it difficult for respondents to process information and to navigate through the questionnaire.<sup>10</sup> Navigation and flow are important in any questionnaire, but they are particularly important in Web-based questionnaires [Redline 99]. Dillman cites research showing that brightness, fonts, and spacing can greatly assist respondents in navigating questionnaires, and that conventional vertical layout with numbered questions and distinct and consistent space between questions and responses make Web questionnaires respondent-friendly [Dillman 01].

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<sup>10</sup> See paragraph labeled “Guidelines” on page 60 for a discussion of the importance of blank space in page layout design.

---

### 4.3.5 Web-Based Questionnaires (continued)

#### **Allowing interruptions**

If your questionnaire is long, you should provide a mechanism that allows respondents to interrupt their work, save it, and then reenter the questionnaire at a later time. (You may then want to send a reminder to the respondent that they have not yet completed the questionnaire.)

If you cannot provide the capability to interrupt, save, and resume, you must make it very clear to respondents that they must complete the questionnaire in a single sitting. Still, in spite of such a warning, you can expect incomplete questionnaires.

#### **Error checking**

One advantage of a Web-based questionnaire is the ability to provide error-checking capabilities. Providing such a capability is especially important if your respondent population possesses varying degrees of Web browsing experience. In general, data quality is improved with error-checking.

Ideally, error messages should be as specific as possible and should be placed directly above or below the item. When you provide error-checking, phrase the term “error” in a positive, helpful way and give suggestions as to how the question should be completed.

#### **Computer & network-based issues**

Keep in mind that while there are many advantages to implementing Web questionnaires, there are several issues, listed below, that could cause some risk if not addressed appropriately.

Do not assume that all respondents will have

- high-speed internet connections
- the same hardware platforms
- the same computer operating systems
- the same types and versions of Internet browsers

The appearance and operation of the Web-based questionnaire needs to be consistent across a variety of hardware and software systems.

If respondents must meet certain system requirements to use the Web-based version of the questionnaire, you must make this absolutely clear and provide alternatives (such as a paper-based version of the questionnaire).

---

### 4.3.5 Web-Based Questionnaires (continued)

#### Pre-testing the implementation

In this section a number of design issues were discussed that should be considered in a Web-based implementation of a survey questionnaire. While many of these guidelines may seem intuitive, your implementation will need to be tested thoroughly.

When testing, remember that respondents will be accessing your questionnaire using different platforms and operating systems and various types and versions of Web browsers. Also consider the impact of network firewalls. Your implementation should be thoroughly tested to account for the various compatibility issues in a heterogeneous network environment.

Have members of your team test the Web-based version of the questionnaire. Encourage your team to enter unusual inputs to find out whether the system can handle erroneous entries. Be sure that answers are not lost and that the submit/save function works properly.

The system should be able to withstand input errors without compromising the user's experience. For example, the system should never "lock-up" due to mistaken inputs, nor should it allow for invalid inputs (e.g., allowing two radio buttons to be checked when your question requires a single input). Also ensure that navigational controls—either the browser's back-button control or navigational controls provided within the questionnaire—do not cause problems. Respondents should be able to back-track to change answers (unless the researcher intentionally prevents this of as part of the question strategy).

This pre-test of the implementation is not the final test. It is simply meant to work out obvious *bugs* in the implementation. Stage 5, Pilot Test Questionnaire, is a critical stage of the process where the implementation, in its entirety, is tested with representative members of the target audience.

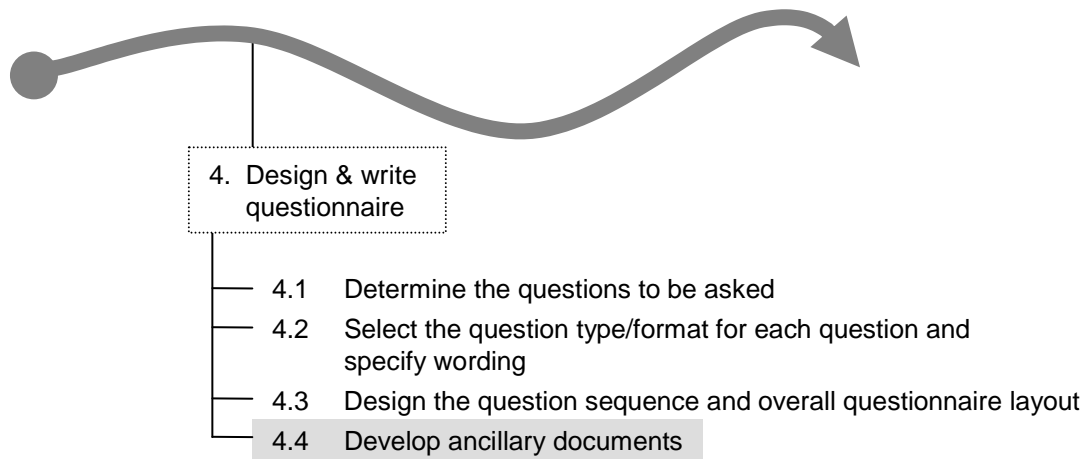


**Stress-test your implementation to get out the *bugs*.**



---

## 4.4 Develop Ancillary Documents



### Introduction

The focus of stage 4 was the questionnaire instrument itself. However, you will also need to develop other ancillary documents that are necessary to support implementation of the survey. These include:

- a pre-notification letter (or email)
- a questionnaire cover letter (for paper-based versions) or an introduction screen (for Web-based questionnaires)
- a reminder letters/emails (to remind respondents to complete the questionnaire before the deadline)
- a thank-you letter (or email)

### Pre-notification letter

A number of researchers have found that a pre-notification letter improves survey response rates. In one study, an 8% increase in response rate was reported [Yu 83]. In a later study, Yammarino reported an average increase in response of 28.5% after the use of a pre-notification letter [Yammarino 91].

However, if you are distributing the pre-notification letter by postal mail, you need to consider the added postage cost. A study by Wright in which he used pre-notification in conjunction with reply paid envelopes, two reminder letters, and a replacement questionnaire found that pre-notification did not increase response rates. In his study, all it did was increase cost [Wright 95].

However, if you are using email rather than postal mail, the additional cost is insignificant and there is no reason not to use a pre-notification letter since it may improve your response rate.

The pre-notification letter covers many of the same points that are covered in the cover letter that accompanies the questionnaire. (See the next paragraph on cover letters.) In addition, it tells respondents **when** they will receive or be provided access to the survey questionnaire.

---

## 4.4 Develop Ancillary Documents (continued)

|   |  |
|---|--|
| <b>The cover letter</b>                                   | <p>The cover letter should include concise statements of</p> <ul style="list-style-type: none"><li>• the purpose of the survey</li><li>• the organization or individuals sponsoring the survey</li><li>• encouragement and/or incentives to participate</li><li>• anonymity or confidentiality (that is, assurance that the respondents and their individual responses will not be revealed, but only combined with many other responses to learn about overall opinions)</li><li>• a list of the sections included in the questionnaire</li><li>• an explanation of how the results will be published and how the results will be used</li><li>• and estimate of how long it will take to complete the questionnaire</li><li>• the calendar deadline for completing the questionnaire</li><li>• a phone number or email address to contact if the recipient has any concerns or questions</li></ul> <p>An example email cover letter appears in Appendix E on page 125.</p> |
| <b>Sponsor</b>  | <p>In some cases, it would be advantageous to have the sponsoring organization's leader sign the cover letter. This can improve response rates by lending credibility to the survey project. It can also communicate a sense of urgency and need for participation.</p>  |
| <b>Incentives</b>   | <p>Numerous studies have demonstrated that incentives will improve survey response rate [Linsky 75, Nederhof 83, Dommeyer 85, Eisinger 74, Turley 99, Gunn 81, Robertson 78, Brennan 92].</p> <p>Some examples of incentives include pens, coffee mugs, and t-shirts. If you believe the respondent will be interested in the results of the survey, then an incentive could be providing a copy of the results.</p>   |
| <b>Introduction screen (for Web-based questionnaires)</b> | <p>The introduction screen of a Web-based questionnaire is essentially the cover letter for the Web-based version. The content (listed above in the paragraph called "The cover letter") is generally the same.</p>  |

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#### 4.4 Develop Ancillary Documents (continued)

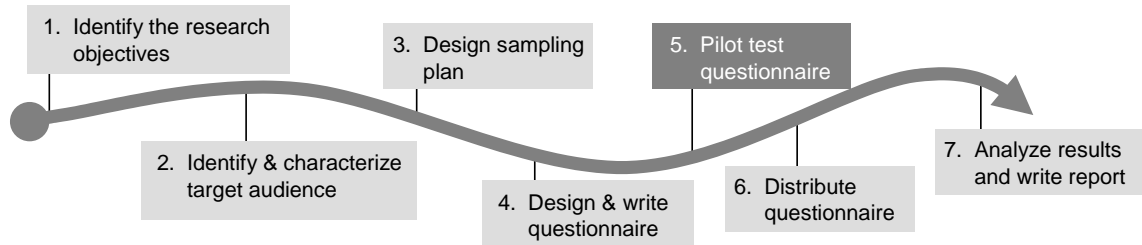
- Reminder letters**      Despite people's best intentions, many will simply forget to complete the questionnaire unless they are reminded. Following distribution of the questionnaire, a reminder letter or letters can be sent to those respondents who have not completed the questionnaire.
- Research has clearly demonstrated that reminder letters are effective for improving response rates. Brennan claims that the most basic approach to achieving high survey response rates is to use at least two reminders (and for mail surveys, to include a copy of the questionnaire with each reminder along with a paid reply envelope) [Brennan 92].
- Reminder letters should be brief and to the point. For Web-based versions, provide the URL for accessing the questionnaire. In both cases, it is a good idea to provide contact information in case the respondent has questions or concerns about how to proceed.
- Keep track of who has responded and who has not and only send reminders to the latter. In this way, you avoid annoying those who have responded with inappropriate email messages.
- 
- Thank you letter**      Consider whether you want to send respondents a brief thank-you note following their participation in your survey. If you are providing incentives, your thank-you note can be sent along with the incentive.
- 
- Conducting team reviews**      Make sure you include the team in reviews of all intermediate documents created during the development process.

---

#### 4.4 Develop Ancillary Documents (continued)

---

## 5 Pilot Test Questionnaire



### Introduction

In the last section, a number of design issues were discussed that should be considered with both paper-based and Web-based implementations. If you followed these guidelines, you might feel confident that you now have a questionnaire that is ready to be distributed to your respondents. Stop right there! The questionnaire is not ready for distribution. While you may have followed the prescribed guidelines, the importance of empirical verification through thorough testing cannot be understated. This is the case for both paper-based questionnaires and Web-based questionnaires.

Up to this point in the survey development process, you have likely invested weeks of your time to get to this point in your questionnaire development. If you are tempted to distribute your questionnaire without testing, then try to imagine your horror when, after distributing the questionnaire, you are bombarded with telephone calls and emails from respondents who were not able to successfully complete your questionnaire due to interpretation difficulties or technical problems. That is not a pretty picture, is it? But the risk is real unless you take the time to test your questionnaire.

### What is a pilot test?

A pilot test is a simulation of your survey implementation carried out on a small scale with members of your target population.

### Are team reviews considered pilot tests?

Team reviews are *not* considered pilot tests. The key characteristic of a pilot test is that you are using actual members of your target audience to test your implementation.

This certainly does not imply that team reviews are not needed. Team reviews are recommended throughout development as the questions are evolving. In fact, it is a good idea to try out the questions on others outside the team to identify weaknesses and potential difficulties.

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*Continued on next page*

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## 5 Pilot Test Questionnaire (continued)

### Are team reviews considered pilot tests? (continued)

Of course, before conducting a pilot test, a good method for identifying difficulties is for the research team to serve as respondents in a pre-test of the questionnaire. This was discussed on page 70.

“The questionnaire designer must understand the need to pretest, pretest, and then pretest some more.”

—Section on Survey Research Methods  
American Statistical Association  
[ASA 99]

### Purpose of pilot testing

Pilot tests are conducted to expose problems or weaknesses in the

- questions
- questionnaire layout
- process
- technology (if a Web-based questionnaire is used)

### Testing the questions

During a pilot test, you should evaluate the questions to determine if

- there is confusion resulting from the instructions
- the *right* questions are being asked
- the questions are understandable
- the order of the questions seems logical
- answer choices (for closed-ended questions) are appropriate and no answer choices have been overlooked
- there are any terms that are not understood or are open to multiple interpretations

### Testing for layout

During a pilot test, you should evaluate the layout to determine if

- there is any difficulty navigating through the questionnaire
- placement of questions (on paper or on the computer screen) is optimal
- font sizes are easy to read
- conventions with the use of bold-face, italics, color, and so forth were consistent and helped the respondent (That is, did these conventions work as intended by the questionnaire designers?)

---

## 5 Pilot Test Questionnaire (continued)

### Testing the process

During a pilot test, you should evaluate the process to determine

- whether the survey objectives are meaningful and of interest to the pilot test respondents
- how interested the respondents are (personally) in the results for the survey
- how long it takes respondents to complete the questionnaire
- how the respondents felt about the length of time to complete the questionnaire
- overall satisfaction with the survey process

Also, ask your pilot participants their opinions of what the duration of the response window should be (that is, the time between the release of the questionnaire to all respondents and the deadline for completion).

### Testing for problems with the technology

If you are using a Web-based questionnaire, you should evaluate the technology to determine if

- erroneous input caused a problem
- respondents were able to navigate easily from screen to screen
- error messages were perceived as friendly and helpful
- there were lag times that caused the respondent to wait before performing a task in the questionnaire
- input data was correctly recorded in the database
- data was lost because it wasn't saved properly

### Approach

The approach you take to the pilot test will depend on whether or not the participants are on-location. Here are some example test scenarios that can be used to conduct the pilot test.

#### When participants are on location

It is best if all pilot participants are in the same room. The research team should observe the respondents completing the questionnaire.

- Begin the pilot test by explaining the process to the participants.
- Take detailed notes, keeping an eye out for signs that individuals are experiencing any difficulties.
- Request written comments about the survey (e.g., ask participants how appropriate the wording of the questions was). Consider preparing an evaluation form that asks your testers to answer questions about specific aspects of their experience.
- After participants have completed the questionnaire, hold a discussion and record all feedback.

---

*Continued on next page*

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## 5 Pilot Test Questionnaire (continued)

### Approach (continued)

#### When participants are off-site

In some cases, pilot participants will be geographically dispersed and you will not be able to observe them directly. Therefore, you will need to prepare clear written instructions and an evaluation form that can serve as stand-alone support for conducting the pilot test.

- The instructions should specify the type of feedback you are looking for. (You can use the information provided within this section to help you determine the type of feedback you want.)
- The evaluation form should capture any and all issues the participants experienced while they completed the questionnaire.
- Instruct the participant to track questionnaire completion time separately from the time required to make notes on evaluation form.
- After completion of the pilot test, collect the evaluation forms and schedule follow-up phone calls to ask clarifying questions about the participant's experience.

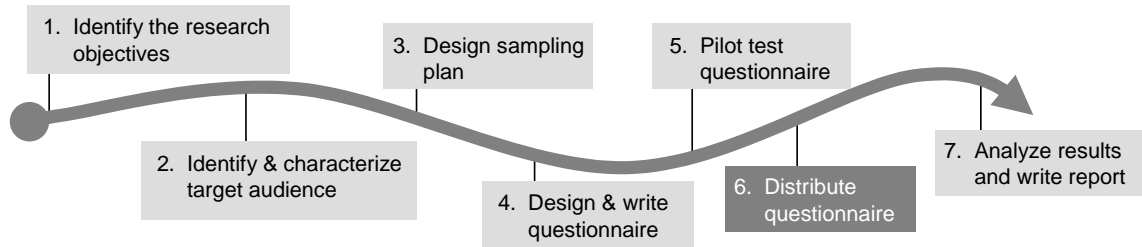
### Using the feedback

Based on the outcome of the pilot test, make the necessary improvements to your questionnaire and implementation alternatives. If you have done a good job of pre-testing the implementation (with members of your team and other colleagues), then any changes required should be fairly minor.



---

## 6 Distribute the Questionnaire



### Introduction

Having thoroughly tested your questionnaire, you are now ready to distribute it or provide access to it.

The respondents should have been pre-notified of your desire for their participation by the time you are ready to distribute the questionnaire. (See page 71 for a discussion of the pre-notification letter and its benefits.) Therefore, it should be no surprise to the respondents when they finally receive the questionnaire or access to a Web-based version of the questionnaire.

This section discusses:

- controlling distribution
- deciding the duration of the response window
- monitoring the response rate
- sending reminders to respondents

### Controlling distribution

To protect the validity of your research approach, you must take precautions so that a questionnaire form cannot be duplicated and submitted multiple times by the same individual, or submitted by an unauthorized individual.

For *paper-based questionnaires* that are mailed or emailed:

- Print a unique alphanumeric identifier on each questionnaire distributed. Keep a list that tracks (a) respondent name, and (b) questionnaire identifier number. The alphanumeric identifier is for administrative purposes only and can be used for different reasons (e.g., to avoid sending needless reminders to individuals who have already responded to the survey).
- If the questionnaire is emailed as an attachment, send a version of the document that cannot be edited (e.g., an Adobe Acrobat with security set so that the file is not editable).

For *Web-based versions of questionnaires*, control access to the questionnaire by providing a unique PIN or username/password combination. (This was discussed briefly on page 64.)

---

## 6 Distribute the Questionnaire (continued)

### Duration of the response window

The response window is the duration between the time the questionnaire is distributed and the deadline for completing the questionnaire.

As you already know, a low level of response to your survey will weaken the study. To maximize the response rate, ensure that you are providing a reasonable amount of time for individuals to respond.

How long should the response window be? In most cases, three to five weeks should be sufficient. But use your best judgment and take into account characteristics of your target population.

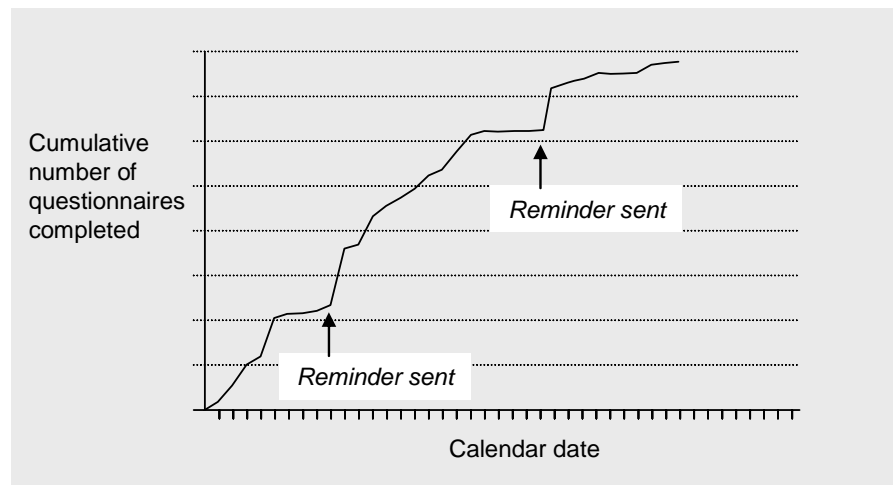
Here are some things to think about:

- Can your audience analysis inform you about characteristics of your respondents that will affect their ability to work on the questionnaire in a timely manner? Ask pilot participants what their opinion was of the duration of the response window (see the paragraph labeled “Testing the process” on page 96).
- If you are releasing the questionnaire during the summer months, be aware that many individuals reserve significant time for vacation (sometimes more than three weeks). During this time, individuals are away from their offices and their computers. Likewise, consider the impact of holidays, especially those toward the end and beginning of the calendar year.

### Monitoring the response rate

Keep track of the response rate after you provide access to the questionnaire. This will help you know when you should send reminders. Keeping track of information such as this can also help you plan future surveys.

Below is an example response-rate graph:



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## 6 Distribute the Questionnaire (continued)

### **When to send reminder letters**

Timing the dispatch of reminder letters depends on the response timeframe you have established and the response rate you observe after you have provided access to the questionnaire.

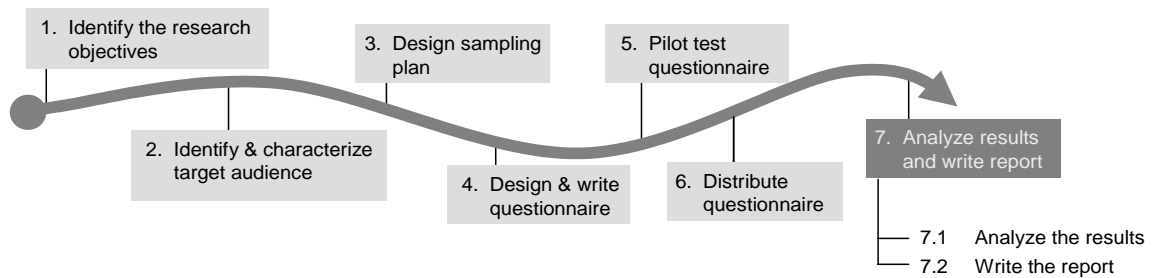
For a two-month response timeframe (that is, respondents have two months to complete the questionnaire before the deadline), you may want to send a reminder after three, five, and seven weeks. If you are using a paper questionnaire sent through the postal mail, then you may only want to send out two reminders (due to cost) during the fourth and sixth week after sending the original questionnaire. With emailed reminders, cost is not a factor.

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**6 Distribute the Questionnaire (continued)**

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## 7 Analyze Results and Write Report – Overview



### Introduction

At this point, the questionnaire completion deadline has been met and you have all of the response data. It has been a lot of work to get here, but the work is far from done.

Now comes the task of pulling the information together to make observations, conduct analyses, make interpretations, and draw conclusions. The vehicle for communicating all of this information is the research report.

The first task ahead of you is to compile the questionnaire data and transform it into meaningful representations that can be interpreted and analyzed. As a result of the analysis, observations are made, leading the researchers to form interpretations and draw conclusions. This is discussed in 7.1, “Analyze the results.”

The second task is to package the analysis as an information product that can be interpreted and used by others. This is the focus of subsection 7.2, “Write the report.”

Your report could take a number of different forms, depending on the particular audience you are addressing. A narrative document (including graphical depictions of the results) will be your key information product. But, it is also likely that you will develop presentations that address various aspects of your research work. And if your work is of interest to the general community, you may want to write journal articles to report your research findings.

### In this section

| Section             | See page |
|---------------------|----------|
| Analyze the results | 84       |
| Write the report    | 98       |

---

## 7.1 Analyze the Results



### Introduction

In this subsection, concepts related to measurement are discussed and guidance is provided for analyzing the survey results.

### If you are using a Web-based questionnaire

One of the major benefits of using Web-based questionnaires is the ease of data collection and data organization: it is all automated. If you are using COTS survey software, then the capability to perform these tasks is embedded in the software. However, it is still necessary to have a thorough understanding of how the software collects and manipulates the data.

If you are using a Web-based questionnaire, you should have already tested the collection and organization of the response information. Also, the export capabilities of the survey application should have been thoroughly tested to ensure accurate transfer of respondent data to spreadsheet programs or specialized statistical packages for further analysis and graphical display.

### If you are using a paper-based questionnaire

If you are using a paper-based version of the questionnaire that has been mailed or emailed to respondents, someone will need to enter the data into the computer manually.

As a precursor to analysis, the data must be

- coded, and then
- organized into a spreadsheet or database

In the case of closed-ended questions in your questionnaire, decisions about *coding* were made when you were constructing the combination of question with response format during question construction (see subsection 4.2.1 beginning on page 42).

There are a number of measurement issues related to the coding of response information and its further quantitative analysis, which are discussed in the next subsection.

---

## 7.1 Analyze the Results (continued)

### Coding

Coding is the assignment of a number value to text. Text responses are coded to ease data entry, facilitate data manipulation, and allow quantitative analysis. There are various ways to assign numbers to questionnaire answer choices. The way numbers are assigned matters because the type of assignment determines the type of measurement analysis that can be undertaken.

The assignment types are classified in terms of the level of measurement used in a question's answer format. They are

- nominal
- ordinal
- interval
- ratio



### Nominal numbers

In a nominal response format, the numbers used have no meaning except as a placeholder for the text response. The numbers *represent* categories. For example, arbitrary number assignments could be made for closed-ended questions with unordered responses (see page 42 for more information about questions with answer choices of this type).

An example of nominal response type assignment of numbers is shown below.

| Response        | Nominal number assignment |
|-----------------|---------------------------|
| Program Manager | 1                         |
| Project Manager | 2                         |
| Engineer        | 3                         |
| Clerical        | 4                         |
| Other           | 5                         |

Nominal number assignments are likely a holdover from the days when responses were transferred to punch cards for computer analysis. Using today's desktop computer applications, nominal number assignments are rarely used.

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## 7.1 Analyze the Results (continued)

### Ordinal type number assignments

An ordinal response format asks respondents to rank-order their preferences in a list. The number indicates a place or position within the list of items.

An example of ordinal response numbers is shown below.

Q7. Rank the importance of the following issues to your job satisfaction by placing a number next to each item (1 = most important, 4 = least important).

|                           |                          |
|---------------------------|--------------------------|
| Education opportunities   | <input type="checkbox"/> |
| Flex-time schedule        | <input type="checkbox"/> |
| Compensation              | <input type="checkbox"/> |
| Friendliness of workplace | <input type="checkbox"/> |

Measurements with ordinal scales are ordered in the sense that each number has a value in relationship to the other. However, the intervals between the numbers are not necessarily equal. For example, on the four-point rating scale measuring attitudes toward job satisfaction, the difference between a rating of 1 and a rating of 2 might not represent the same difference as the difference between a rating of 3 and a rating of 4. There is no true zero point for ordinal scales since the zero point is chosen arbitrarily. The lowest point on the rating scale in the example above was arbitrarily chosen to be 1. It could just as well have been 0 or -4.

Therefore, it would be wrong to calculate the average of the ratings for one of the listed items. The result would make no sense. Ordinal numbers cannot be analyzed by calculating averages. The correct way to report the results would be to report frequencies of how each item was ordered in a particular way. Median values can be reported, but not averages.



---

## 7.1 Analyze the Results (continued)

### Likert scales are ordinal

Another ordinal response scale was discussed on page 45—the Likert scale.

Because Likert scales are ordinal, it would be wrong to make the assignments listed below with the intention of combining and manipulating the assigned numbers to form averages. Likert scale response information must be reported as frequencies within each category.

| Response          | Scale |
|-------------------|-------|
| Strongly disagree | 1     |
| Disagree          | 2     |
| Undecided         | 3     |
| Agree             | 4     |
| Strongly Agree    | 5     |

### Interval number assignments

With interval numbers, the distance between attributes does have meaning (although the scale does not possess an absolute zero point).

It is not generally possible to develop closed-ended questionnaire responses that map to an interval scale. Response scales are typically ordinal in nature.

### Ratio type

Ratio-type response information can be averaged and formed into ratios. With ratio numbers, there *is* an absolute zero. This means that you can construct meaningful fractions with ratio numbers. In survey research, ratio numbers are found with *count numbers*. For example, when you ask the respondent “how many?” types of questions.

An example of ratio-type response numbers is shown below.

Q3. List the total number of on-board full-time equivalents (FTE) for FY2005 in your organization, including both Government and Contractor personnel.

## 7.1 Analyze the Results (continued)

### Organizing your information

If you are using hard copy forms of the questionnaire, it will be necessary to organize the response information into a spreadsheet or database. Many spreadsheet programs provide powerful native tools for statistical analysis and graphical depiction. Also, most spreadsheets can export the spreadsheet information to computer applications that focus on statistical analysis.

The easiest way to do this is to organize a spreadsheet area with each row corresponding to a single respondent and the columns representing the specific answer choice variables. For a questionnaire that has ten questions with each question having five possible answer choices, the number of columns would be expressed by

$$\text{Number of columns} = 10 * 5 = 50 \text{ columns}$$

If there are 500 respondents in the sample, then the table would be a 500 row by 50 column matrix.

The example below depicts part of a spreadsheet matrix. The letters represent answer choices for each question. The white part of the matrix is where the questionnaire results would be entered. The number “1” is entered for a response alternative selected by a given respondent.

|               | Question #1 |    |    |    |    | Question #2 |    |    | ... | Question #n |    |    |    |    |  |
|---------------|-------------|----|----|----|----|-------------|----|----|-----|-------------|----|----|----|----|--|
|               | a.          | b. | c. | d. | e. | a.          | b. | c. | ... | a.          | b. | c. | d. | e. |  |
| Respondent #1 |             | 1  |    |    |    |             |    | 1  |     |             |    |    | 1  |    |  |
| Respondent #2 |             |    | 1  |    |    |             |    |    |     | 1           |    |    |    |    |  |
| ⋮             |             |    |    |    |    |             |    |    |     |             |    |    |    |    |  |
| Respondent #n | 1           |    |    |    |    |             | 1  |    |     |             | 1  |    |    |    |  |

### Statistical analysis of the results

Once the data has been organized appropriately, statistical analysis can be conducted. Statistical analysis for survey data examines response patterns—frequencies of different responses, what response occurred most frequently for each question within a group, variation in responses within a group, and differences in ways different subgroups (within the same survey) responded.<sup>11</sup>

<sup>11</sup> Subgroup analysis is possible using cross-tabulation discussed on page 95.

---

## 7.1 Analyze the Results (continued)

### Displaying the data

The first task of the analysis is to determine the frequency distribution of responses for each question. The term “distribution” means the frequency of each value selected by the respondents over the range of all valid values. There are essentially two ways to present data to support analysis:

- graphical display (charts and graphs)
- tables

For large amounts of response data (which typically result from surveys), you will want to display your frequency distributions graphically. Graphical presentations are covered in the following paragraphs. There are situations when tabular information is preferred, which are discussed briefly after issues about graphical presentations are covered.

### Graphical presentation

Quantitative research is about collecting, analyzing, and interpreting numbers. However, the human mind is rather limited when it comes to understanding patterns within lists of raw numbers. In order to make sense of large volumes of data, the raw numbers need to be transformed into something intelligible, such as a graph or picture.

With today’s technology, almost any type of data graph can be displayed with standard applications available on every desktop. However, it is still up to the human-in-the-loop to ensure good design.

What is good design? Good design supports the data and the analysis of the data. Effective presentation of data is an art form. A well-designed graph presents data clearly and accurately. It exposes the data’s features of interest—that is, the *message* within the data.

A complete treatment of the development of graphs is beyond the scope of this document. However, a number of guidelines are presented in the following paragraphs as tips for developing effective graphs of your data.

### Examples of charts and graphs used in surveys

The right chart can facilitate analysis and interpretation. While there are many different ways to display data, some of the more popular ways include bar charts (both vertical and horizontal), pie charts, and, to a lesser extent, line graphs and box plots. While these types of charts and graphs do not represent all the ways that data can be presented, they are the predominant methods used but for survey data.

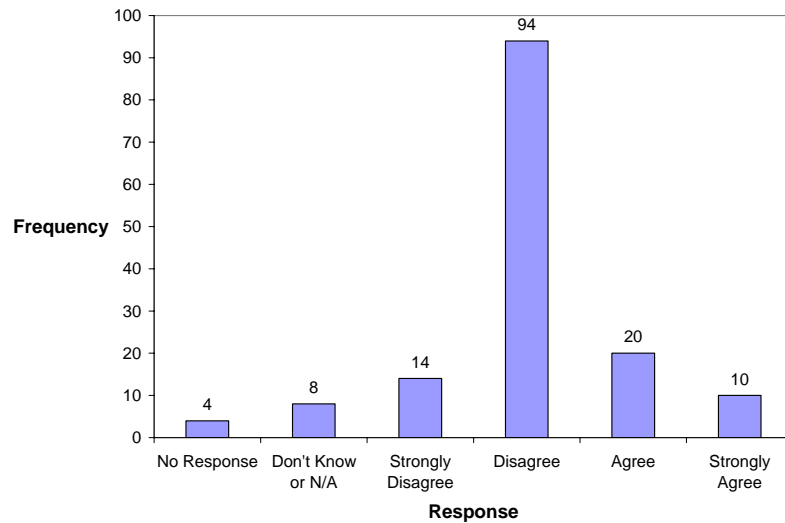
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## 7.1 Analyze the Results (continued)

### Vertical bar chart

The vertical bar chart is sometimes called a column chart. It is the most commonly used method for comparing the frequency or magnitude of the that appear along the horizontal axis. The length of the bar is proportional to the value it depicts. Bar charts can also be used to depict time series data when the number of time intervals is small.

This is an example of a basic vertical bar chart.

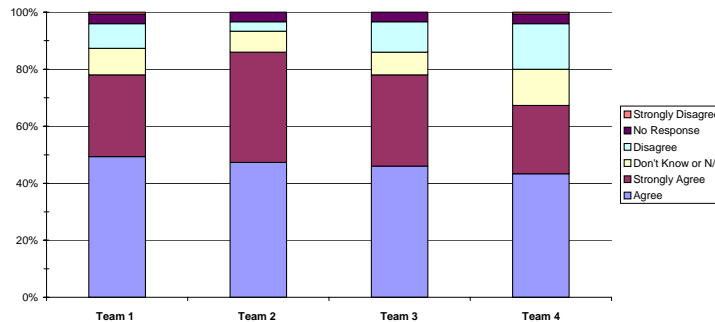


### Stacked vertical bar chart

The basic vertical bar chart can be varied in a number of ways. One variation is the stacked vertical bar chart. The stacked bar chart consists of one or more segmented bars, with each segment of a bar representing the relative share of a total that the component contributes.

Subdivided bar charts are *not* a preferred format [Rutchik 98]. They should be used with caution. It is difficult to make comparisons among the second, third, or subsequent segments in a stacked bar since the comparison is not being made from a common base.

Below is an example of a stacked vertical bar chart.



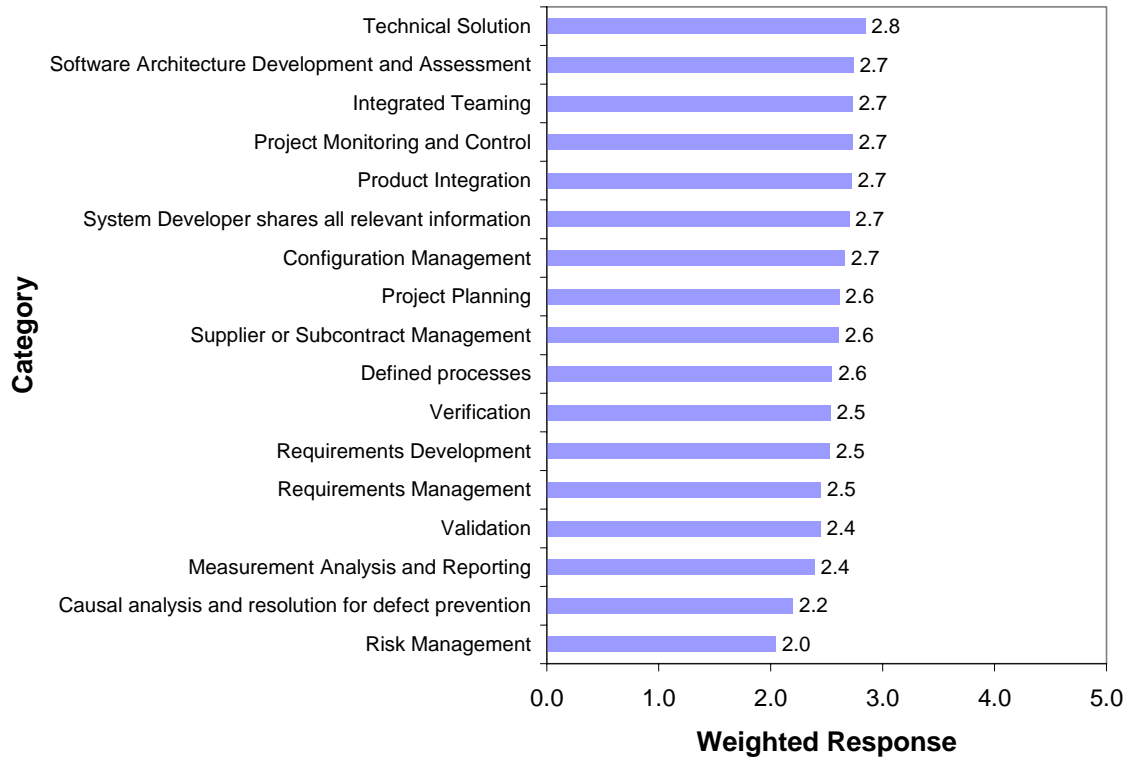
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## 7.1 Analyze the Results (continued)

### Horizontal bar charts

Horizontal bar charts are like vertical bar charts turned sideways. One advantage of this presentation is the extra room on the vertical axis for labels. This is especially important when the number of bars to be portrayed is relatively large. Also, there is a better sense of continuity when a horizontal label is combined with a horizontal bar [Chambers 83, Schmid 83].

Below is an example of an ordered horizontal bar chart



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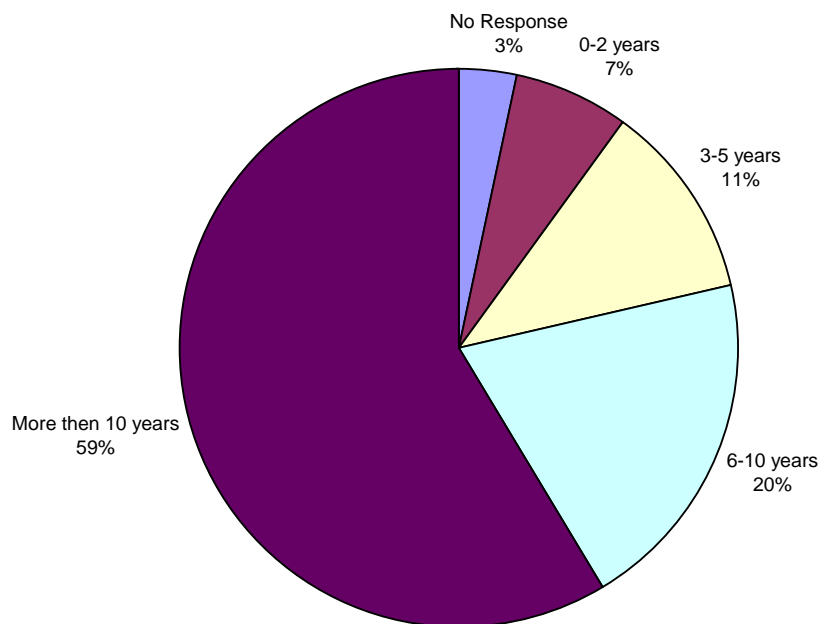
## 7.1 Analyze the Results (continued)

**Pie chart** A pie chart is a circular diagram divided into segments, with each segment representing a category or subset of data. The value or amount of each category is proportional to the size of the sector. The total area of the circle represents the entire sample being shown.

Pie charts are popular because they are simple and are sufficient to display simple messages. But, they have limited utility [Rutchik 98]. Tufte states that “the only worse design than a pie chart is several of them” [Tufte 83].

Despite their popularity, pie charts should be used sparingly for two reasons. First, they should only be considered for displaying statistical information when there are no more than six components; otherwise, the resulting picture will be too complex to understand. Second, pie charts are not useful when the components have similar values because it is difficult to see the differences between slice sizes.

An example of a pie chart is shown below. (There are many other variations of the “pie chart” theme.)



---

## 7.1 Analyze the Results (continued)

### Other types of graphs & charts

Some of the common ways to display survey data graphically have been described briefly. However, there are other valid ways that might be more suitable depending on the features you are trying to expose within your data set.

For example, a *line graph* can show a visual comparison between two survey variables better than a bar chart. In some cases, a box plot can be very descriptive for showing the distribution of a survey variable that is continuous in nature [Tukey 77]. To read more about the use of box plots, see Hayes [Hayes 95].

You should explore other methods that may be useful for describing your survey data. Experiment with different ways of plotting the data to see what works best for you [Tufte 83].

### Misuse of graphics

Graphs and charts are often misused. The honest researcher must have a good handle on how graphs can be used to mislead rather than inform. Huff shows a good selection of methods that can be used to make numbers say something different from what the actual data supports. He looks at graphical presentation, correlations, collection of data, sample size, sample bias, and other critical factors that can enter into the validity of statistics and of the conclusions we try to draw from them [Huff 54]. Tufte also describes the many ways charts and graphs can mislead through poor design [Tufte 83].

### Guidelines for effective graphs & charts

Detailed design guidance is beyond the scope of this document. To find out more about this topic, review the words of Kosslyn, Cleveland, and Tufte for excellent treatment of the issues involved with effective graph and chart design [Kosslyn 93, Cleveland 94, Tufte 83].

The following is a summary of some of key guidelines from these authors:

- From a design perspective, keep the graph as simple as possible for the analysis purpose at hand. Do not use three-dimensional (3-D) effects or fancy crosshatching. They often distort or hide data, making comprehension difficult or impossible.
- Always include the total sample size as part of the graph or chart.
- Don't settle for the default graph that is provided by a software application. Try different types of graphs and charts and choose the one that works best.
- Comparing the size of bars in a bar chart is easier than comparing slices in a pie chart.

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*Continued on next page*

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## 7.1 Analyze the Results (continued)

### Guidelines for effective graphs & charts (continued)

- Use scaling consistently within a graph or chart and across graphs and charts that will be compared. Use equal increments if possible.
- Clearly label the X and Y axes and including the unit that is being measured.
- Use conventional graphing methods. For example, time should be plotted along the X axis.
- Use compatible colors within charts and don't use too many colors. Be consistent with the use of colors and fonts in a series of charts or graphs.
- Test the colors you select for graphs and charts with your printer. The colors do not always print as viewed on your screen. Consider whether you or others will print your color graphics on a black and white printer. If this is the case, you need to test your color hues to ensure that they can be discriminated after printing grayscale or black and white.
- Use rectangular plots rather than square. The human eye seems to be trained to look for horizontal effects. It tends to scan side-to-side better than up-and-down [Tuft 83].

In almost all cases, use a zero baseline as the anchor of your Y axis scale since the vertical scale represents size or amount. The design principle at operation is that the *area* displayed is proportional to the quantity of interest. If the scale is not baselined at zero, then the proportions will be hidden from view.

### When to use tables

In some instances a data table is better than a graphical display. A small table sometimes can be more effective than a large graph.

In general, tables are better than graphs for giving precise, structured numeric information, whereas graphs are better for indicating trends and making broad comparisons or showing relationships.

Tables are also better for making localized comparisons between parts of a data set. In some cases, you might want to include a table to complement a graph of the same information.

Ehrenberg states that tables should be used instead of graphics when you have 20 or fewer numbers, while Zawitz suggests that tables should be used when you have 10 or fewer numbers.

Ehrenberg and Zawitz provide other helpful suggestions for making tabular presentations effective [Ehrenberg 81, Zawitz 00].



---

## 7.1 Analyze the Results (continued)

### Cross-tabulation: deeper analysis of your data

“Cross-tabulation” is a method used to make comparisons between two or more nominal variables. Cross-tabulation can be used when you want to know how categories of respondents answered the same question.

In some cases, cross-tabulation is a strategy that the research team planned a priori for evaluating the survey results. In other instances, results are cross-tabulated due to interesting questions that surfaced as a consequence of initial analysis of the survey results.

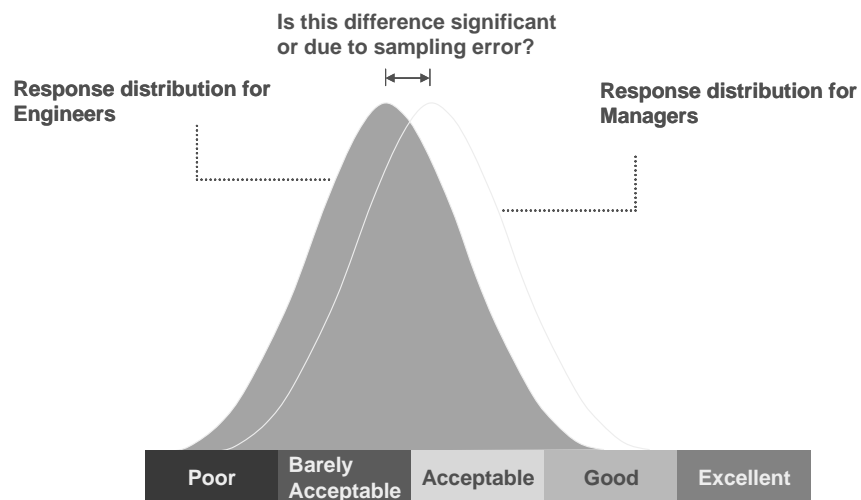
For example, consider a survey that includes executives, project managers, engineering staff, and clerical staff. You might want to compare their answers to specific questions to determine if there are differences based on an individual’s position in the organization.

### Statistical significance between subgroups

When you cross-tabulate to examine differences between two subgroups in your survey, you might want to test to find out if the differences are statistically significant.

Various statistical tools can be used to determine whether the differences are *real* and not simply due to sampling error associated with the precision specified in the sampling plan. If the test determines that a difference is larger than what might have occurred by chance, the difference is said to be “statistically significant.”

Developing the appropriate statistical tests requires knowledge of statistical concepts and theory that is beyond the scope of this document. For an excellent treatment of this topic, consider publications by Backstrom and Williams [Backstrom 81, Williams 79].



---

## 7.1 Analyze the Results (continued)

### What about the open-ended questions?

As stated previously on page 40, open-ended questions should be used sparingly and carefully in self-administered surveys. Long narrative responses to questions are very difficult and sometimes impossible to interpret and quantify. However, under certain circumstances, you may want to include one or two as part of your questionnaire.

Responses to open-ended questions must be processed manually, which is very time-consuming. The researcher must examine each response, interpret it, and then apply judgment to filter the response into categories that emerge as additional responses are analyzed. Filtering and categorization can corrupt the original intention of the respondent and that is, of course, a threat to validity.

### Approach: categorizing responses to open-ended questions

The Affinity Diagram Technique is a tool that gathers large amounts of language data (e.g., ideas, opinions, issues), organizes it into groupings based on the natural relationship between each item, and defines groups of items [Brassard 96]. One of the best ways to analyze responses to open-ended questions is through a structured team approach using an adaptation of the technique. In this way, categorization of open-ended response information does not rely on a single person's opinion but is arrived at through team consensus. Steps for this technique are listed below.

#### Set-up

1. Each narrative response is placed in a bordered table cell. The font size should be increased to 14-16 points so the responses can be read by a group of people standing at a distance.
2. Use a paper cutter to separate each response from the other.
3. Position the responses on a large conference table (or on more than one table).

#### Arrange the Responses into Related Groupings

4. Look for two responses that seem to be related in some way. Place those two side-by side. Look for other responses that are related to each other or to the original two responses that were set aside. Repeat this process until you have all of the responses placed into 6-10 groupings. Do not force-fit single responses into groupings in which they don't belong. These "loners" may form their own grouping or never find a home.

Keep the following in mind:

- This is a silent process. It is most effective to have everyone move the pieces of paper at will, without talking. Talking sometimes encourages unhelpful semantic battles that can rage on and on.

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*Continued on next page*

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## 7.1 Analyze the Results (continued)

- Disagreements over the placement of responses should be handled simply and undiplomatically: if you don't like where a response is, move it! It will all eventually settle into consensus.

### **Create the Category Name for Each Group**

5. Look for a response in each grouping that captures the central idea that ties all of the responses in that group together. This is referred to as a header card. A header card is placed at the top of each grouping. Many times, no such card exists, and a header card must be created. The header card should be concise.

### **Construct Frequency Distribution Chart or Table of Results**

6. Develop an appropriate representation of the results that makes it easy to compare frequency counts within each category.

### **Making comparisons**

Once all data has been compiled and transformed into something easy to interpret (e.g., graphs, charts, cross-tabulations) you can begin to make comparisons between responses to various questions.

For example, if a number of question addressed a particular topic (e.g., requirements management), you would want to compare responses from question to question to determine if there was consistency.

### **Reviewing related literature**

Based on the type of survey you are conducting, you might want to review the literature so that you can compare your results to those of other.

---

## 7.2 Write the Report



### Introduction

By now, your research is complete. You have gathered all the data together and have developed charts, graphs, and tables that allowed you to make observations and form interpretations. Now, it is time to begin thinking about the content of your survey report.

The survey report is the concrete evidence of your research project. In all likelihood, the quality of your research will be judged by how you write this report that conveys your ideas and the findings of the survey. For this reason, it is important to carefully consider the content, organization, and clarity of your survey report.

Your report will probably take a number of different forms, depending on the particular audience you are addressing. A narrative document (including graphical depictions of results) will be your key information product. But, it is also likely that you will develop presentations that address various aspects of your research work. If your work is of interest to the general community, you might also want to write journal articles to report your research findings.

### Adjusting from detail to big-picture

Up until now, you have been mired in minute details for weeks and perhaps months—with aspects of the sampling plan, wording choices for questions, appropriate response formats for questions, testing your implementations in various ways, and finally wrestling with the analysis and interpretation of the results. But now, you need to take the big-picture view and let go of a lot of the minutiae that has been consuming you. The task at hand is to translate your research work into a perspective that will be understood by your audience.

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## 7.2 Write the Report (continued)

### Getting started

Before diving into writing your report, you should think through the information that you have to present. Sit down at your word processor and write responses to the questions and statements listed below. The answers you provide will become the basis for your report.

- What was the purpose of this survey research?
- Make a list of people who contributed to the research. Could they be involved in writing or making a contribution (as a reviewer) to the report? What contribution could they make? Plan to acknowledge contributors and the sponsor within your report if appropriate.
- Compile a list of the work of others that is related to the survey research you have conducted.
- Describe the background leading up to the research.
- What factors did you consider to be threats to measurement validation?
- What did you do to counter known threats to validation?
- Were there any unanticipated events or issues that arose that would threaten the validity of your results?
- Describe or list the key finding of your research. What specific observations (within the results) led you to these findings?
- Describe the consequences of your research. How will the results be used? Will anyone be impacted by the results? If so, who?
- Do you have recommendations to make based on your results? What are they?

Answering these questions will help you get started writing a report. But before you actually begin writing it, take a careful look at the audience that you believe will be reading it. Who are they and what will they expect?

### Conduct an audience analysis

It is very important to take stock of who will read your report—before you begin the report and while you are writing it. You want your report to communicate well to your audience, so you need to consider their information needs. Not only do you want to use language that your audience will understand, you want to ensure that you provide the right amount of detail. In some cases, you might have more than one audience. You might want to hide detail for one audience, but make it accessible by providing the detail in an appendix for your other audience. The key point: write for the readers of the report—not for yourself.

You should ensure that the report provides enough detail about your method that someone skilled in survey research could reproduce your work. But it is also best to assume that readers are busy people and they will want information presented to them clearly and concisely.

Thinking about your audiences before you write the report can help you know the appropriate level of detail to include and how the report should be organized.

---

## 7.2 Write the Report (continued)

### **Audience analysis: questions to ask**

You might want to ask the following questions while conducting your audience analysis:

- Who is the primary audience? What positions do they hold in their organizations (e.g., executive, management, engineers)?
- Are there secondary audiences? If so, what positions do they hold in their organizations?
- Why will the audience want to read the report?
- What does the audience already know about the topic that your research covers?
- What is the most important thing for this audience to understand from reading your report?
- Are there important terms or procedures in your research that your audience will not be familiar with? List them.

After you draft your report, return to your audience analysis and see if you have addressed the points you raised by answering the questions above.

### **Report organization**

Many books have been published about writing research reports. Most research reports contain the same major sections, although the names of the sections vary widely and it is appropriate to omit some sections and add others. (The audience analysis can help you with such decisions.)

One way to organize your report is as follows:

- Title page
- Table of Contents
- Abstract (or Executive Summary)
- Introduction
- Research Method
- Results
- Conclusions and Recommendations
- Reference Section
- Appendix

These sections are described in upcoming paragraphs.

---

## 7.2 Write the Report (continued)

### Title page

As you begin your report, you may start with a **working title**, but you should be open to changing the title once the report is finished so that it accurately describes your research paper.

As with the body of the report itself, it is important to consider your audience when developing a title for your survey report.

Develop a title that will make your audience want to read the rest of the report. Also consider whether your report will be published or available on the Web and consider including a keyword in the title to facilitate successful searches for your document.

As part of the title page, you might also want to include the name of the organization sponsoring your work, the date, and your name. Depending on the contribution level of other people, you might want to include their names with yours, or put them in an “Acknowledgements” section of your paper.

### Comment about authorship

Tufte spends fifteen pages in his book, *Visual Explanations*, talking about the Challenger disaster in the mid-1980s [Tufte 97]. In short, the scientists at NASA had an opportunity to stop the launch of the ill-fated space shuttle. Tufte surmises that if they had presented the data better, the scientists might have been able to convince the decision makers not to push the button. Although he spends considerable time in the details of the actual presentation, Tufte first notes that the title slide did not include the names of the authors.

In the past, many of us have noticed that “team culture” seems to discourage individual ownership. However, this habit must be changed because, as Tufte states about the slides in the challenger presentation, “authorship indicates responsibility, both to the immediate audience and for the long-term record.” Without any accountability, a research report “might well provoke some doubts about the evidence to come.”

### Table of Contents

The table of contents serves two purposes: it tells your readers how to navigate the document and it demonstrates how the report is organized.

---

## 7.2 Write the Report (continued)

### Abstract

An abstract is an accurate representation of the contents of a document, in an abbreviated form. If your report is for senior management, then your abstract becomes an “executive summary.”

An abstract can be difficult to write because you must describe your subject matter, explain what was done, and present key results and interpretations, all in one short paragraph of about 150 words.

Although the abstract appears at the beginning of your document, it should be written last so you can ensure that it reflects your written report accurately.

### Introduction

The Introduction prepares your reader for the report that follows by presenting the:

- research purpose
- problem statement
- scope
- background
- statement of the hypothesis or hypotheses if applicable

It is, of course, important to consider the *purpose* of your research in the introduction.

State the general *problem* area and discuss the importance and significance of the problem area.

The scope refers to the ground covered and not covered in your survey research. It can also help the reader understand limiting factors that constrained your research.

The background includes facts that the reader must know in order to understand the discussion that follows. You may want to include elements of any literature review that you conducted in the background.

If your survey was designed to test a hypothesis, then clearly state that hypothesis and what the research team predicted.



---

## 7.2 Write the Report (continued)

### Research Method

The Research Method section should include the following subsections:

- Sampling
- Measurement
- Design and Procedures

The “Sampling” subsection should clearly describe the procedure used to select the respondents in the survey. The population (sampling frame) should be identified clearly. The specific sampling method should be identified (e.g., self-selected vs. random) and the sample itself should be accurately described in terms of number and any other attributes of interest.

The “Measurement” subsection should briefly describe the questionnaire instrument that was used. The instrument itself should appear in the appendix. Always report the response rate. Discuss any possible threats to construction validity and describe what you did to counteract those threats. (Construct validity is described on page 12.) Trochim provides an excellent detailed discussion of construct validity and other types of measurement validity issues [Trochim 01].

The “Design and Procedures” subsection should describe how the research was conducted. The collection method should be described in detail (including, for example, whether incentives were used to increase the response rate). The entire sequence of events should be described such that another skilled researcher could replicate the method. Also, use this subsection to discuss threats to external validity (see page 12) and the ways that you either mitigated these or were not able to control for them.

### Results section

In the Results section, you will finally be able to show what you discovered or observed through your survey research. All preceding sections of the report led to the results section of the report and all subsequent sections will refer back to it and consider what the results mean.

In the research section, focus on the *facts* of your research by presenting them in a straightforward way. You will need to decide whether all of your charts, graphs, and figures should be presented in this section or only the important ones. In the latter case, you could place some information in an appendix if it seems more appropriate for your audience. In any case, you should provide access to all information collected during the survey.

Present only the data in the Results section. You may share certain observations here, but postpone interpretations and suppositions until the next section, “Conclusions and Recommendations.”

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*Continued on next page*

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## 7.2 Write the Report (continued)

### Results section (continued)

Throughout the section described in stage 7.1, Analyze the Results, the importance of charts, graphs, and table design was emphasized. The design of your presentations is all the more important when you are presenting them within your report. Graphics and illustrations need to be self-contained. They should make complete sense on their own without reference to the text. After drafting your Results section, return to the guidance of section 7.1 and evaluate the quality of your illustrations based on criteria given.

“Good design is clear thinking made visible, bad design is stupidity made visible.”<sup>12</sup>

- E.R. Tufte

### Conclusions & Recommendations section

This section is sometimes titled Discussion, but the more descriptive title Conclusions and Recommendations better informs the readers of what this section is about. In this section, you will interpret your results as a whole. If appropriate for your particular research topic, you will also discuss the relationship of your findings to earlier research. Finally, you will make recommendations based on the outcome of your research.

This section is important because it demonstrates the meaning of your research. Your interpretation will be most convincing if it proceeds logically. An effective way of doing this is to organize your information from what you are most certain about to what you are least certain about. Consider developing your argument using this outline:

- begin with a discussion of the data
- generalize about or analyze the data
- consider how the data addresses the research problem or hypothesis
- discuss what can be inferred from the data as they relate to other research (if appropriate)
- make recommendations about the type of research that should follow from your investigation or how to use your results

An important aspect of your report is the identification of any limitations of your research and their nature. This is especially important when your results are inadequate (e.g., due to poor response rate), do not support your hypothesis, or are not consistent with earlier studies on the topic that you researched. Do not try to defend your research by minimizing the seriousness of the limitations, but instead focus on the limitation itself as it affects the research and objectively try to account for it.

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*Continued on next page*

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<sup>12</sup> Tufte, E.R. “Presenting Data and Information,” [Workshop]. Arlington, VA, Nov. 9, 1999.

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## 7.2 Write the Report (continued)

### **Conclusions & Recommendations section (continued)**

Drawing conclusions follows logically from your interpretations of the data. The most important thing is to state your conclusions clearly. Do not be ambiguous. Be careful to distinguish between conclusions (“The research demonstrates ...”) and inferences (“The research suggests ...”).

Once you have stated your conclusions, discuss their implications. However, your research may have actually raised more questions than it answered. Discussing ambiguous data does not mean that your work is incomplete or faulty. Rather, it demonstrates your non-bias and the intellectual honesty of your work, connecting it to the larger body of scientific methodology.

Finally, recommendations should be listed when further work needs to be done. In many situations, a single survey is the starting point for future dialogue and studies of a topic. That is why our survey process diagram depiction ends with an arrow. Your recommendations demonstrate that you fully understand the importance and implications of your research as you suggest ways that it can be continued.

### **The References section & Appendix**

If you include a section on the background of your research topic or discuss other theories or models related to your work, you need to include a References section. You should include references you cited in your report or that informed your research.

The appendix is a place for information that is relevant to your research but needs to be kept separate from the main body of the report to avoid interrupting the line of development of the report. An appendix should contain only one *type* of information. If you plan to include several sets of data, then include several appendices. Label each with a capital letter (e.g., Appendix A, Appendix B, Appendix C).

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## 7.2 Write the Report (continued)

---

# After the Survey

## Introduction

You have completed the survey and written your report. If it was your first experience developing a survey, you are probably very surprised that it was so much work. As shown by List, those new to survey development typically underestimate the amount of effort required to design and develop a survey and analyze the results. “While it is easy to write a questionnaire, it takes skill and experience to write a good questionnaire: one in which every question is clear, can be answered accurately, and has usable results” [List 05].

## Is your work finished?

In many cases, your work is not finished with the release of your survey report. “Often ‘truth’ will not win without an advocate” [Backstrom 81]. In almost all cases, you will be asked to deliver a presentation of your findings to management or others. Your report will need to be repackaged to accommodate this type of delivery.



Be aware that research findings can sometimes contradict the pet ideas of colleagues and managers, so you may need to defend the research against attacks by others whose ideas are threatened by the research outcomes.

Researchers are seldom the final decision makers. But, as researchers, we should make certain that the survey findings are given a hearing and are perceived correctly.

## Sharing data

You should always be willing to share information about your research. However, be wary of how certain points might be skimmed off of the cream of your careful analysis for topical reports to support others' favored points. The problem is not that your data is being used, but that it is being used without providing the context of the deeper analysis and caveats that you may have cautioned about in your report.

If this occurs, all you can do is address the issues when you learn of them by helping the user of your data understand the key underpinnings of your research that will assist proper interpretation.

---

## After the Survey (continued)

### Getting to the truth?

Getting to the *truth* about a system or a complex situation is difficult.

Data triangulation refers to the use of multiple data collection and analysis methods whereby the strengths of one method compensate for the weaknesses of another.

The purpose of triangulation is to obtain confirmation of findings through convergence of different perspectives. The point at which the perspectives converge is seen to represent reality.

As time goes on, your survey will be looked upon to add information to an existing body of knowledge that builds upon many sources of information to establish the *truth*.

Surveys must be constructed properly in order for them to withstand the test of time.

---

# Appendices

**In the  
Appendices**

| <b>Section</b>  | <b>See page</b> |
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# Appendix A: Approaches to Data Gathering

## **Introduction**

The data-gathering approach chosen should be dictated by the information needs of the researcher. Different approaches produce different kinds of information.

This appendix describes various research-based approaches for gathering data.

## **Approaches to data gathering**

Survey research is but one approach for collecting information to gain insight into the people and problems under study. Other approaches include the following:

- documentary research
- laboratory experiments
- action research
- case studies
- field experiments
- field work: participant observation and ethnography
- simulation
- in-depth interviews

The best approach to use depends on the information needed for the problem at hand.

## **Documentary research**

One of the first things researchers should determine is whether the information they are seeking already exists. Checking sources such as the Web, libraries, public offices, and private associations might help researchers avoid conducting redundant and possibly wasteful surveys.

## **Laboratory experiments**

A laboratory experiment with human subjects can be designed to explain behavior by noting what happens as some new element is introduced. Subjects used are typically those who sign up voluntarily. Conclusions drawn from such experiments, therefore, cannot be applied to just anyone, anywhere [Backstrom 81].

---

## Appendix A: Approaches to Data Gathering (continued)

### Action research

Action research involves a family of research methodologies that pursue action (i.e., change) and research (i.e., understanding) at the same time [Dick 99]. In most of its forms, action research involves

- using a cyclic or spiral process which alternates between action and critical reflection
- continuously refining methods, data, and interpretation in subsequent cycles, in the light of the understanding developed in the earlier cycles

### Case studies

A case study is an intensive study of a specific individual or context [Trochim 01]. There is no single way to conduct a case study. A combination of methods (such as unstructured interviewing and direct observation) can be used. Friedman provides a fine example of case study use in the domain of systems engineering and management in acquisition systems [Friedman 04].

### Field experiments

When conducting field research, the researcher goes into the field to observe the phenomenon in its natural state. The field researcher typically takes extensive field notes that are subsequently coded and analyzed [Trochim 01]. Controlled field experiments require a special kind of rigorous structure, called experimental design. Although the experiments occur in the field, their form is like that of a chemistry experiment in the laboratory. The researcher observes a real-world group (the “before”), adds a new ingredient (the “treatment”) and observes any changes (the “after”) [Backstrom 81].

### Field work

The ethnographic approach to qualitative research comes largely from the field of anthropology. The researcher becomes immersed in the culture as an active participant and records extensive field notes. In an ethnographic study there is no preset limiting of what will be observed and no predefined ending point [Trochim 01].

### Simulation

Simulation is usually a mathematical, computer-generated model of the real world. By duplicating the “world” with statistical techniques and by varying the values of the model parameters, this approach attempts to predict how conditions will change in response to new values. Simulations can be generalized to the extent that the data and relationships used in them have been previously verified by separate research [Backstrom 81].

---

## Appendix A: Approaches to Data Gathering (continued)

### In-depth interviews

The in-depth interview is an exploratory approach. Each topic is probed deeply—following up important leads with further questions—until a well-rounded picture emerges. The results of this time-consuming inquiry cannot be applied to a larger group because one cannot know how representative the respondents are of the larger group [Backstrom 81].

### Comparison of approach by information goals

The figure below summarizes a comparison of major research approaches by information goals (adapted from Backstrom 81, page 11).

|                                | No generalization  | Generalization  |
|--------------------------------|--|---|
| Describes what behavior exists | <ul style="list-style-type: none"><li>• Depth interview</li><li>• Action research</li><li>• Field work</li></ul> | <ul style="list-style-type: none"><li>• Survey</li></ul>  |
| Describes what causes behavior | <ul style="list-style-type: none"><li>• Case study</li><li>• Human laboratory experiment</li></ul>               | <ul style="list-style-type: none"><li>• Controlled field experiment</li><li>• Simulation</li><li>• Physical laboratory experiment</li></ul> |



---

# Appendix B: Applications of Survey Research in Systems and Software Engineering

## Introduction

Assumptions are your personal interpretations of phenomena or information that you have about a system. When this information is based on casual study, hearsay, untested inferences, or limited experience, the assumptions on which you act may not be sound. That is why structured and systematic data-collection and analysis approaches must be used, such as those available through survey research.

The use of properly designed surveys can help provide needed insight into complex systems and software engineering issues in a timely and accurate way to support more effective problem-solving and decision-making.

The purpose of this appendix is to provide some examples of common ways surveys have been used in software and systems engineering environments.

## Problem identification

In order to stay relevant and competitive in the global economy, organizations must continually seek ways to improve their people, processes, and technologies.

But what are the high-leverage improvement opportunities that can provide the greatest impact? To answer this question (at least in part), surveys can gather the multi-level perspectives of the organization.

### **For example:**

Under the auspices of the Under Secretary of the Army, a large-scale program was initiated for the purpose of making dynamic improvements in the Army's acquisition system.

While there are many changes that could be made to the system, there were many different opinions as to what the focus should be for improvement during the next several years.

Therefore, a survey was designed and distributed to nearly all Army Acquisition program managers to elicit what they believed were the key problems and risks they faced each day [Kasunic 04].

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## Appendix B: Applications of Survey Research in Systems and Software Engineering (continued)

### Employee and customer satisfaction

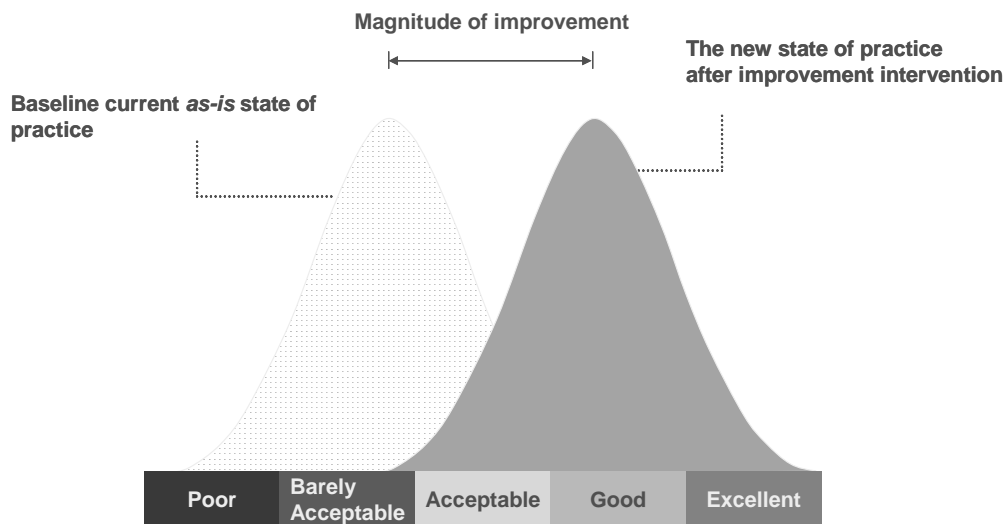
It is in the best interests of companies and organizations to maintain optimal relationships with both their employees and customers. Many organizations conduct periodic surveys to understand what is working well and what needs to improve.

### Process improvement validation

Many organizations are working to improve the way they do business and are engaged in various initiatives to do so (e.g., CMMI, Six Sigma, software architecture design improvement, interoperability).

While the best avenue to assessing the success of improvement efforts lies in first-hand performance measurement of key characteristics of interest, a more rounded-out picture will emerge if surveys are used to gauge the perceptions of those affected by the intended improvement change.

For example, consider a process that is to be *improved*. To better understand whether the change intervention accomplished its objective, a survey questionnaire could be administered before and after the change. A comparison of the results of the before and after surveys can help assess the perceived impact of the change, as illustrated in the example diagram below.



Example of survey results before and after improvement change is made.

---

## Appendix B: Applications of Survey Research in Systems and Software Engineering (continued)

### **Understanding the state of the practice & community needs**

Quite often, surveys are used to gauge the state of the practice across the systems and software engineering community or a portion of it. The purpose of these surveys is to uncover data that can be used to identify and prioritize the needs of the community. In this way, decision-making can be informed so that research, technology, or product and service development can be channeled in those areas that perceive to be most relevant to the stakeholders.

The following documents provide examples of these types of surveys:

- *Pittsburgh Regional Delphi Study - Software and Corporate Technology* [Tide 04].
- *The 1999 Survey of High Maturity Organizations* [Paulk 99].
- *After the Appraisal: A Systematic Survey of Process Improvement, its Benefits, and Factors that Influence Success* [Goldenson 95].

### **Short topical surveys with limited distribution**

Small group surveys are often administered to obtain feedback and improvement suggestions. Here are some examples:

- evaluation questionnaire after attending a training course
- meeting evaluation questionnaire
- questionnaire to obtain feedback after a new innovation has been introduced into your organization
- questionnaires about particular topics of interest in the workplace

These types of surveys are usually given to everyone within a group. A survey that includes the entire population in the sample is called a “census.”

Even though a questionnaire might be targeted to a small group of people, (e.g., a class of 25 people who are evaluating a training course), the researcher should take care in designing the instrument so that the information obtained is meaningful and interpretable.





## Appendix C: Example Activity Breakdown for a Survey Research Project

The example activity breakdown structure below is for organizing survey research work. The list of activities and responsibilities need to be tailored based on the type of survey intended

| Activity  | Responsibility                 |
|---|--------------------------------|
| <b>Identify &amp; characterize research problem</b>                                     |                                |
| Define and document research objectives   | Researcher, SMEs <sup>13</sup> |
| Define and document research questions  | Researcher, SMEs               |
| Conduct review with management  | Researcher, SMEs, Management   |
| Define and document how survey results will be used                                     | Researcher, SMEs, Management   |
| Map research questions to objectives  | Researcher                     |
| Review and finalize objectives and internal questions                                   | Researcher, SMEs, Management   |
| <i>Is a survey research approach appropriate? If so continue with plan.</i>             |                                |
| <b>Define population (target audience)</b>  |                                |
| Define appropriate audience for survey (sampling frame)                                 | Researcher, SMEs               |
| Verify that sampling frame can be enumerated  | Researcher                     |
| Obtain contact information for sampling frame   | Researcher                     |
| Conduct audience analysis and document  | Researcher, SMEs               |
| Determine appropriate media for target audience (Web-based, mail, email, etc.)          | Researcher, SMEs               |
| Recruit members of target audience to participate in pilot test of survey <sup>14</sup> | Researcher                     |
| <b>Design sampling plan</b>   |                                |
| Define desired confidence and precision   | Researcher                     |
| Select sample   | Researcher                     |
| Document sampling approach  | Researcher                     |
| Review sampling approach  | Researcher, SMEs               |
| <i>Sampling plan approved</i>   |                                |

<sup>13</sup> Subject Matter Experts

*Continued on next page*

<sup>14</sup> Although pilot test does not happen until much later in the development, it is desirable to secure commitment early on.

**Appendix C: Example Activity Breakdown for a Survey Research Project  
(continued)**

| <b>Activity</b>  | <b>Responsibility</b>          |
|--|--------------------------------|
| <b>Develop paper-based questionnaire</b>   |                                |
| Translate research questions into appropriate questions for respondents                    | Researcher                     |
| Select question type/format and specify wording for each question                          | Researcher                     |
| Review questions and prioritize list of questions. Pare down list to fit size constraints. | Researcher, SMEs               |
| Organize and sequence questions  | Researcher                     |
| Write instructions, definitions, and transition paragraphs                                 | Researcher                     |
| Conduct team review  | Researcher, SMEs, Management   |
| Revise questionnaire based on review   | Researcher                     |
| Conduct external review with other stakeholders <sup>15</sup>                              | Researcher, other stakeholders |
| Revise questionnaire based on external review  | Researcher                     |
| Conduct internal pre-test of paper version of questionnaire                                | Researcher, SMEs               |
| Revise questionnaire based on internal pilot test  | Researcher                     |
| Final edit of paper-based questionnaire  | Technical Writer, Researcher   |
| Final draft of paper-based version is completed  |                                |
| Develop ancillary survey documents   |                                |
| Write pre-notification letter  | Researcher                     |
| Write cover letter   | Researcher                     |
| Write follow-up reminder notes   | Researcher                     |
| Conduct team review  | Researcher, SMEs, Management   |
| Revise based on team review  | Researcher                     |
| Conduct final edit of ancillary survey documents   | Technical Writer, Researcher   |
| Ancillary documents completed  |                                |

*Continued on next page*

<sup>15</sup> It is a good idea to obtain buy-in from other subject matter experts who are not participating on the team. Obtaining buy-in at this early stage will increase belief or acceptance of the survey results.

**Appendix C: Example Activity Breakdown for a Survey Research Project  
(continued)**

| <b>Activity</b>  | <b>Responsibility</b>               |
|--|-------------------------------------|
| <b>Develop requirements for Web-based version of questionnaire<sup>16</sup></b>      |                                     |
| Define questionnaire access mechanism  | Researcher                          |
| Define interrupt/resume requirements   | Researcher                          |
| Define response format requirements  | Researcher                          |
| Specify screen layout desires  | Researcher                          |
| Specify output requirements  | Researcher                          |
| Meet with survey tool programmer to discuss requirements and agree on implementation | Researcher, Web Programmer          |
| Document meeting outcomes and agreements   | Researcher                          |
| <b>Develop Web-based version of questionnaire</b>                                    |                                     |
| Write content for introduction screen  | Researcher                          |
| Enter all information into web-based survey tool                                     | Web Programmer                      |
| Conduct review   | Researcher, SMEs                    |
| Revise web questionnaire   | Researcher, Web Programmer          |
| Conduct usability test   | Researcher, SMEs                    |
| Revise web questionnaire based on test   | Researcher, Web Programmer          |
| <b>Conduct Pilot Test</b>  |                                     |
| Develop evaluation form for pilot test   | Researcher                          |
| Conduct pilot test   | Researcher, Pilot Test Participants |
| Evaluate feedback  | Researcher, SMEs                    |
| Revise both paper-based version of questionnaire and Web-based version               | Researcher, Web Programmer          |
| <b>Conduct final edit</b>  |                                     |
| Conduct team review  | Researcher, SMEs, Management        |
| Revise based on team review  | Researcher                          |
| Final edit before questionnaire distribution   | Technical Writer, Researcher        |
| Questionnaire ready for distribution   |                                     |

*Continued on next page*

<sup>16</sup> The assumption here is that a web-based survey application is pre-existent and has been used already within the organization. If this is not the case, then the research team would need to conduct an evaluation of available technologies and select the appropriate application to support the research needs.

**Appendix C: Example Activity Breakdown for a Survey Research Project  
(continued)**

| <b>Activity</b>  | <b>Responsibility</b>        |
|--|------------------------------|
| <b>Distribute questionnaires &amp; track responses</b> |                              |
| Distribute questionnaires                              | Researcher                   |
| Track responses  | Researcher                   |
| Send reminder #1                                       | Researcher                   |
| Send reminder #2                                       | Researcher                   |
| Response deadline                                      |                              |
| <b>Process survey responses</b>                        |                              |
| Develop graphical depictions of response information   | Researcher                   |
| Conduct analysis                                       | Researcher                   |
| Write report   |                              |
| Write initial draft                                    | Researcher                   |
| Conduct team review of draft                           | Researcher, SMEs             |
| Revise draft   | Researcher                   |
| Review and provide mark-up of report                   | Technical Writer             |
| Revise report  | Researcher                   |
| Conduct final team review                              | Researcher, SMEs             |
| Conduct final edit                                     | Technical Writer, Researcher |
| Report complete  |                              |

# Appendix D: Likert-Type Response Alternatives

## Agreement

|   |  |   |
|---|--|---|
| <ul style="list-style-type: none"> <li>• Strongly agree</li> <li>• Agree</li> <li>• Undecided</li> <li>• Disagree</li> <li>• Strongly disagree</li> </ul> | <ul style="list-style-type: none"> <li>• Agree</li> <li>• Undecided</li> <li>• Disagree</li> </ul> | <ul style="list-style-type: none"> <li>• Agree very strongly</li> <li>• Agree strongly</li> <li>• Agree</li> <li>• Disagree</li> <li>• Disagree strongly</li> <li>• Disagree very strongly</li> </ul> |
|---|--|---|

## Frequency

|   |   |   |
|---|---|---|
| <ul style="list-style-type: none"> <li>• Very frequently</li> <li>• Frequently</li> <li>• Occasionally</li> <li>• Rarely</li> <li>• Very Rarely</li> <li>• Never</li> </ul> | <ul style="list-style-type: none"> <li>• Always</li> <li>• Very frequently</li> <li>• Occasionally</li> <li>• Rarely</li> <li>• Very rarely</li> <li>• Never</li> </ul> | <ul style="list-style-type: none"> <li>• Almost always</li> <li>• To a considerable degree</li> <li>• Occasionally</li> <li>• Seldom</li> </ul> |
|---|---|---|

|   |  |   |
|---|--|---|
| <ul style="list-style-type: none"> <li>• Often</li> <li>• Sometimes</li> <li>• Seldom</li> <li>• Never</li> </ul> | <ul style="list-style-type: none"> <li>• Always</li> <li>• Very Often</li> <li>• Sometimes</li> <li>• Rarely</li> <li>• Never</li> </ul> | <ul style="list-style-type: none"> <li>• A Great Deal</li> <li>• Much</li> <li>• Somewhat</li> <li>• Little</li> <li>• Never</li> </ul> |
|---|--|---|

*Continued on next page*

## Appendix D: Likert-Type Response Alternatives (continued)

### Quality

|  |   |  |
|--|---|--|
| <ul style="list-style-type: none"> <li>• Excellent</li> <li>• Above Average</li> <li>• Average</li> <li>• Below Average</li> <li>• Extremely Poor</li> </ul> | <ul style="list-style-type: none"> <li>• Very Good</li> <li>• Good</li> <li>• Barely Acceptable</li> <li>• Poor</li> <li>• Very Poor</li> </ul> | <ul style="list-style-type: none"> <li>• Good</li> <li>• Fair</li> <li>• Poor</li> </ul> |
|--|---|--|

|  |  |  |
|--|--|--|
| <ul style="list-style-type: none"> <li>• Very Superior</li> <li>• Superior</li> <li>• Borderline</li> <li>• Poor</li> <li>• Very poor</li> </ul> | <ul style="list-style-type: none"> <li>• Very adequate</li> <li>• Slightly adequate</li> <li>• Borderline</li> <li>• Slightly inadequate</li> <li>• Very inadequate</li> </ul> | <ul style="list-style-type: none"> <li>• Totally adequate</li> <li>• Very adequate</li> <li>• Barely adequate</li> <li>• Borderline</li> <li>• Barely inadequate</li> <li>• Very inadequate</li> <li>• Totally inadequate</li> </ul> |
|--|--|--|

### Likelihood

|   |  |  |
|---|--|--|
| <ul style="list-style-type: none"> <li>• Almost Always True</li> <li>• Usually True</li> <li>• Often True</li> <li>• Occasionally True</li> <li>• Sometimes But Infrequently True</li> <li>• Usually Not True</li> <li>• Almost Never True</li> </ul> | <ul style="list-style-type: none"> <li>• Definitely</li> <li>• Very Probably</li> <li>• Probably</li> <li>• Possibly</li> <li>• Probably Not</li> <li>• Very Probably Not</li> </ul> | <ul style="list-style-type: none"> <li>• To A Great Extent</li> <li>• Somewhat</li> <li>• Very Little</li> <li>• Not At All</li> </ul> |
|---|--|--|

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## Appendix E: Example Email Cover Letters

The letter below is from the NOAA Software Survey [NOAA 96].

NOAA is conducting a survey to gain a better understanding of its current software systems and software activities. To ensure that NOAA's software management process is an integral part of NOAA's Information Technology planning program, the Systems Acquisition Office is working in collaboration with the Information Systems and Finance Office and the Environmental Data and Information Services Strategic Planning Team to conduct this software survey. A Software Survey Team composed of representatives from NOAA Line and Staff Offices have worked to develop and implement this survey.

The survey results are not intended to invoke mandated "improvement" standards and processes. The understanding gained from the survey will be used, first, to identify "best practices" which currently exist within NOAA, second to define potential improvements, and, third, to serve as a reference against which future comparisons are made as candidate improvements are prototyped and implemented.

If you have any questions at any time regarding this activity, please contact XXXX or XXXX of the Systems Acquisition Office at (XXX) XXX-XXXX.

Your responses to this questionnaire are important to us. They will help us develop the most complete and accurate understanding possible of software within NOAA. The questionnaire should take no more than one hour to complete. When you are finished completing the questionnaire, please promptly return it to XXX.

Thank you for taking the time to complete this questionnaire.

---

## Appendix E: Example Email Cover Letters (continued)

The letter below is an adaptation of an example provided by Couper [Couper 01].

From: Michigan Daily Survey

Sent: Tuesday, March 30, 1999 2:52 PM

To: [e-mail address]

Subject: Michigan Daily Student Survey

Dear University of Michigan Student:

You have been selected at random as part of a sample of 1,600 currently enrolled students at The University of Michigan to participate in a survey organized by *The Michigan Daily*. We are interested in campus life and in your opinions about some University of Michigan policies that affect students, including affirmative action. We need your answers to make our survey a more accurate representation of student views. Your participation in the study is completely voluntary, and your answers will not be linked to you by name in anyway. The overall results from the survey will be presented in series of articles in *The Michigan Daily*.

You can complete the survey whenever it is convenient for you at any computer where you can get access to the World Wide Web. It will take you about 15 minutes. The information you provide us is very important to the accuracy of our survey. No one from the study staff will be able to connect you to your answers. As a token of our appreciation, we would like to offer you a gift to thank you for your participation in the survey. When you complete the survey, you will receive instructions about how to claim a copy of The Daily's color book *We're No. 1: The 1997 National Championship Season*.

Thank you in advance for completing the survey. You are contributing to the discussion of important campus issues that will begin when the survey results are published in The Daily.

Please use MS Explorer or Netscape versions 4 or higher.

Enter this unique CASE IDENTIFICATION NUMBER: [ID]

Use this PASSWORD to verify your eligibility as a study participant: [password]

To start the survey, just go to: <http://survey.isr.umich.edu/michsurvey/welcome.htm>

If you have questions about the survey or are having trouble signing on to the web site, please contact either one of us.

Michael W. Traugott

Department of Communication Studies

xxxxx@umich.edu

Jennifer Yachnin

The Michigan Daily

xxxxx@umich.edu



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## References

- [ASA 99] Section on Survey Research Methods—American Statistical Association. *Designing a Survey*. <http://www.amstat.org/sections/srms/brochures/designquest.pdf> (1999).
- [Backstrom 81] Backstrom, C. H. & Hursh-César, G. *Survey Research, 2<sup>nd</sup> Ed.* New York, NY: Macmillan Publishing Company, 1981.
- [Bilak 95] Bilak, P. *Illegibility*. <http://desktoppub.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=desktoppub&zu=http%3A%2F%2Fwww.ty.p.nl%2FTYP04%2Fwoud%2FIllegibility%2FIllegibility02.html>. (1995).
- [Brassard 96] Brassard, M. *The Memory Jogger Plus + Featuring the Seven Management and Planning Tools*. Salem, NH: Goal/QPC, 1996.
- [Brennan 92] Brennan, M. “Techniques for Improving Mail Survey Response Rates.” *Marketing Bulletin 3* (1992): 24-37.
- [Burchell 92] Burchell, B. & Marsh, C. “The Effect of Questionnaire Length on Survey Response.” *Quality and Quantity 26*, (1992): 233-244.
- [Chambers 83] Chambers, J. M.; Cleveland, W. S.; Kleiner, B.; & Tukey, P. A. *Graphical Methods for Data Analysis*. Belmont, CA: Wadsworth, 1983.
- [Cleveland 94] Cleveland, W. S. *The Elements of Graphing Data*. Summit, NJ: Hobart Press, 1994.
- [Cochran 77] Cochran, W.G. *Sampling Techniques, 3<sup>rd</sup> Ed.* New York, NY: John Wiley and Sons, 1977.
- [Couper 00] Couper, M. “Web Surveys: A Review of Issues and Approaches.” *Public Opinion Quarterly 64*, 4 (2000): 464-481.
- [Couper 01] Couper, M.; Traugott, M.; Lamias, M. “Web Survey Design and Administration.” *Public Opinion Quarterly 65* (2001): 230-253.
- [Deming 60] Deming, W.E. *Sample Design in Business Research*. New York, NY: John Wiley & Sons, 1960.
- [Dick 99] Dick, B. (1999) *What is Action Research?* <http://www.scu.edu.au/schools/gcm/ar/whatisar.html>.
- [Dillman 01] Dillman, D. & Bowker, D. *The Web Questionnaire Challenge to Survey Methodologists*. <http://survey.sesrc.wsu.edu/dillman/papers/websurveyppr.pdf>. (2001).
- [Dillman 78] Dillman, D. A. *Mail and Telephone Surveys: The Total Design Method*. New York, NY: Wiley, 1978.

---

**References (continued)**

- [Dommeyer 85]** Dommeyer, C. "Does Response to an Offer of Mail Survey Results Interact With Questionnaire Interest?" *Journal of Market Research* 27, 1 (1985): 27-38.
- [Ehrenberg 81]** Ehrenberg, A. S. C. "The Problem of Numeracy." *The American Statistician* 35, 2 (1981): 67-71.
- [Eisinger 74]** Eisinger, R.; Janicki, W. P.; Stevenson, R.; & Thompson, W. "Increasing Returns in International Mail Surveys." *Public Opinion Quarterly* 38, 1 (1974): 124-130.
- [Feller 68]** Feller, W. *An Introduction to Probability Theory and Its Applications, Volume 1, 3rd Ed.* New York, NY: John Wiley & Sons, 1968.
- [Friedman 04]** Friedman, G., & Sage A. P. "Case Studies of Systems Engineering and Management in Systems Acquisition." *Systems Engineering* 7, 1 (2004): 84-97.
- [Goldenson 95]** Goldenson, D. R. & Herbsleb, J. D. *After the Appraisal: A Systematic Survey of Process Improvement, Its Benefits, and Factors that Influence Success* (CMU/SEI-95-TR-009, ADA302225). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, 1995. <http://www.sei.cmu.edu/publications/documents/95.reports/95.tr.009.html>
- [Gunn 81]** Gunn, W. J. & Rhodes I. N. "Physician Response Rates To a Telephone Survey: Effects of Monetary Incentive Level." *Public Opinion Quarterly* 45, 1 (1981): 109-115.
- [Hayes 95]** Hayes, W. & Zubrow, D. *Moving On Up: Data and Experience Doing CMM-Based Process Improvement* (CMU/SEI-95-TR-008/ESC-TR-95-008). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, 1995.
- [Heberlein 78]** Heberlein, T. & Baumgartner, R. "Factors Affecting Response Rates To Mailed Questionnaires: A Quantitative Analysis of the Published Literature." *American Sociological Review* 43 (1978): 447-462.
- [Helgeson 94]** Helgeson, J. G. & Ursic, M. L. "The Role Of Affective and Cognitive Decision-Making Processes During Questionnaire Completion." *Public Opinion Quarterly* 11, 5 (1994): 493-510.
- [Herzog 81]** Herzog, A. R. & Backman, J. G. "Effects Of Questionnaire Length on Response Quality." *Public Opinion Quarterly* 45 (1981): 549-559.
- [Huff 54]** Huff, D. *How to Lie with Statistics*. New York, NY: W. W. Norton & Company, 1954.
- [Israel 92]** Israel, G. D. "Determining Sample Size." *Program Evaluation and Organizational Development, Fact Sheet PEOD-6* (1992). [http://edis.ifas.ufl.edu/scripts/htmlgen.exe?DOCUMENT\\_PD006](http://edis.ifas.ufl.edu/scripts/htmlgen.exe?DOCUMENT_PD006).

---

## References (continued)

- [James 90] James, J. M. & Bolstein, R. "The Effect of Monetary Incentives and Follow-Up Mailings on the Response Rate and Response Quality in Mail Surveys." *Public Opinion Quarterly*, 54 (1990): 346-361.
- [Kallenberg 97] Kallenberg, O. *Foundations of Modern Probability*. New York, NY: Springer-Verlag, 1997.
- [Kasunic 04] Kasunic, M. *Army Strategic Software Improvement Program (ASSIP) Survey of Army Acquisition Managers (CMU/SEI-2004-TR-003)*. Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, 2004. <http://www.sei.cmu.edu/publications/documents/04.reports/04tr003.html>
- [Kish 65] Kish, L. *Survey Sampling*. New York, NY: John Wiley and Sons, 1965.
- [Kosslyn 93] Kosslyn, S. M. *Elements of Graph Design*. New York, NY: W.H. Freeman and Company, 1993.
- [Likert 32] Likert, R. "A Technique for the Measurement of Attitudes." *Archives of Psychology* 140 (1932): 7.
- [Linsky 75] Linsky, A. S. "Stimulating Responses To Mail Questionnaires: A Review." *Public Opinion Quarterly* 39, 1 (1975): 82-101.
- [List 2005] List, D. *Know Your Audience: A Practical Guide to Media Research*. Wellington, New Zealand: Original Books, 2005.
- [Lozar 02] Lozar Manfreda, K.; Batagelj, Z; & Vehovar, V. "Design of Web Survey Questionnaires: Three Basic Experiments." *Journal of Computer-Mediated Communication* 7, 3 (April 2002). <http://www.swiftinteractive.com/white4.asp>.
- [Moser 89] Moser C. A. & Kalton G. *Survey Methods in Social Investigations*. Aldershot, UK: Gower, 1989.
- [Nederhof 83] Nederhof, A. "The Effects Of Material Incentives In Mail Surveys." *Public Opinion Quarterly* 47, 1 (1983): 103-111.
- [NOAA 96] NOAA Software Survey Team. *NOAA Software Survey Final Report*. U.S. Department of Commerce, 1996.
- [Oishi 02] Oishi, S. M. *How to Conduct In-Person Interviews for Surveys, 2nd Ed.* Thousand Oaks, CA: Sage Publications, 2002.
- [Paulk 99] Paulk, M. C.; Goldenson, D.; & White, D. M. *The 1999 Survey of High Maturity Organizations (CMU/SEI-2000-SR-002, ADA377375)*. Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, 1999. <http://www.sei.cmu.edu/publications/documents/00.reports/00sr002.html>
- [Payne 80] Payne, S. *Art of Asking Questions (Studies in Public Opinion)*. Princeton, NJ: Princeton University Press, 1980.

---

## References (continued)

- [Redline 99] Redline, C. D. & Dillman, D. A. *The Influence of Auxiliary, Symbolic, Numeric, and Verbal Language on Navigational Compliance in Self-administered Questionnaires*. <http://survey.sesrc.wsu.edu/dillman/papers/Auxiliary,Symbolic,Numeric%20paper--with%20Cleo.pdf>. (1999).
- [Robertson 78] Robertson, D. & Bellenger. "A New Method of Increasing Mail Survey Responses: Contributions to Charity." *Journal of Marketing Research* 15, 4 (1978): 632-633.
- [Rutchik 98] Rutchik, R. H. *EIA Guidelines for Statistical Graphs*. Statistical Standards Group, Energy Information Administration (EIA), Department of Energy. <http://www.eia.doe.gov/neic/graphs/preface.htm> (1998).
- [Schmid 83] Schmid, C. F. *Statistical Graphics: Design Principles and Practices*. New York, NY: John Wiley and Sons, 1983.
- [Scholtes 88] Scholtes, P.R. *The Team Handbook*. Madison, WI: Joiner Associates, 1988.
- [Stevens 59] Stevens S. Ch 2, "Measurement, Psychophysics and Utility," 59. *Measurement: Definitions and Theories*, New York, NY: John Wiley, 1959.
- [Tide 04] Technology Insertion, Demonstration, and Evaluation (TIDE) Program. *Pittsburgh Regional Delphi Study—Software and Corporate Technology*. <http://www.sei.cmu.edu/tide/publications/surveys.htm> 2004.
- [Trochim 01] Trochim, W. M. K. *Research Methods Knowledge Base, 2nd Ed*. Cincinnati, OH: Atomic Dog Publishing, 2001.
- [Trotter 59] Trotter, H. F. "An Elementary Proof of the Central Limit Theorem." *Archiv der Mathematik [Archives of Mathematics]* 10 (1959): 226-234.
- [Tufté 83] Tufté, E. R. *The Visual Display of Quantitative Information*. Chesire, CT: Graphics Press, 1983.
- [Tufté 97] Tufté, E. R. *Visual Explanations: Images and Quantities. Evidence and Narrative*. Chesire, CT: Graphics Press, 1997.
- [Tukey 77] Tukey, J. W. *Exploratory Data Analysis*. Reading, MA: Addison-Wesley, 1977.
- [Turley 99] Turley, S. "A Case Of Response Rate Success." *Journal of the Market Research Society* 41, 3 (1999): 301-309.
- [Williams 79] Williams, F. W. *Reasoning with Statistics, 2nd Ed*. New York, NY: Holt, Rinehart, and Winston, 1979.
- [Wright 95] Wright, M. "The Effect of Pre-Notification on Mail Survey Response Rates: An Experimental Result." *Marketing Bulletin* 6 (1995): 59-64.

---

**References (continued)**

- [Yamane 67]** Yamane, Taro. *Statistics, 2nd Ed.* New York, NY: Harper and Row, 1967.
- [Yammarino 91]** Yammarino, F. J.; Skinner, S. J.; & Childers, T. L. "Understanding Mail Survey Response Behavior: A Meta-Analysis." *Public Opinion Quarterly*, 55 (1991): 613-639.
- [Yu 83]** Yu, J. & Cooper, H. "A Quantitative Review of Research Design Effects on Response Rates to Questionnaires." *Journal of Marketing Research* 20 (1983): 36-44.
- [Zawitz 00]** Zawitz, M.W. *Good Tables: Numbers Have Architecture*.  
<http://www.science.gmu.edu/%7Ewss/methods/index.html#Graphics>. (2000).

---

**References (continued)**

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