A CLEAR FRAMEWORK AROUND WHICH TASKS can be identified and linked is essential for collaboration in a large geodesign effort. For more than thirty years I have worked with and refined a general framework for the design professions that I first published in 1990. This framework for geodesign consists of six questions that are asked (explicitly or implicitly) at least three times during the course of any geodesign study. These questions have sub-questions that are modified as needed by the geodesign team. The answers to those questions are models, and their content and levels of abstraction are particular to the individual case study. Some modeling approaches can be general, but data and model parameters are local to the people, place, and time of the study, as are the geodesign actions whose consequences are being studied.

The framework for a particular geodesign study will be shaped by its many participants, and especially by the issues and requirements posed by the people of the place, along with other relevant people and institutions (figure 3.1). However, frequently these stakeholders do not agree, and these tensions are a common catalyst for a geodesign study. The stakeholders will likely want to be in close contact with the geodesign team at all stages of the work. The proposed designs must reflect their priorities, and in the case of disagreement among the stakeholders, alternatives will need to be developed. The geodesign

Figure 3.1: The stakeholders, the geodesign team, and the framework for geodesign. | Source: Carl Steinitz.
team also maintains a responsibility to consider alternatives beyond those already known and imagined. All of the products and results, including alternative designs and the assessments of their impact, will need to be presented for stakeholder review and their many decision processes. This framework does not suggest a singular linear process, but one which has several iterative “loops” and feedback possibilities. Deviations certainly occur during the reality of geodesign projects, but following the organized sequence of these questions provides beneficial structure to any geodesign activity.

The six questions of the framework

These key questions are the following:

1. *How should the study area be described in content, space, and time?* This question is answered by **representation models**, the data upon which the study relies.

2. *How does the study area operate? What are the functional and structural relationships among its elements?* This question is answered by **process models**, which provide information for the several assessment analyses of the study.

3. *Is the current study area working well?* This question is answered by **evaluation models**, which are dependent upon the cultural knowledge of the decision-making stakeholders.

4. *How might the study area be altered? By what policies and actions, where and when?* This question is answered by **change models**, which will be developed and compared in the geodesign study. These also generate data that will be used to represent future conditions.

5. *What differences might the changes cause?* This question is answered by **impact models**, which are assessments produced by the process models under changed conditions.

6. *How should the study area be changed?* This question is answered by **decision models**, which, like the evaluation models, are dependent upon the cultural knowledge of the responsible decision makers.

The three iterations through the framework

Over the course of the geodesign study, each of these six primary questions and their subsidiary questions are asked three times. In the first iteration through the sequence (figure 3.2), they are asked rapidly, beginning with question 1 as it defines the context and scope of the work. In this first iteration we treat these as *WHY* questions for the project. In the second iteration, the same six primary questions are asked in reverse order from 6 to 1. This identifies and defines the methods of study, the *HOW* questions. And in the third iteration, they are asked again in the original order of 1 to 6 as we implement the study method and address the *WHAT, WHERE, and WHEN* questions.

It is important to emphasize that designing is not just proposing changes, as question 4 alone might suggest. Whether explicitly or implicitly, all six questions must be satisfied throughout all three iterations of the framework for a geodesign study to be complete. Decisions by the stakeholders may then lead to implementation of change.
The first iteration: The WHY questions

![Diagram of the first iteration process]

The objective of the first iteration is to understand the geographic study area and the scope of the study. So in this iteration, the six questions, asked in order from 1 to 6, are intended to answer WHY the study is to happen. The geodesign team will consider past and present descriptions and representations of the region and develop a general knowledge of how the landscape works in that place. Through this first iteration the geodesign team comes to understand the problems, issues, opportunities, and constraints of the place, the objectives of the geodesign application, and the relevant content and scale(s) of possible change. Possible changes and their potential types of impacts will be identified. The answers to the six questions also lead to an understanding of how the decision-making processes may operate for this particular geodesign activity.

Some typical initial questions that might be posed during this first iteration include the following:

1. **Representation:**
   - Where is the study area? How should it be defined?
   - What are its physical, ecological, economic, and social geographies?
   - What are its physical, ecological, economic, and social histories?

2. **Process:**
   - What are the area's major physical, ecological, economic, and social processes?
   - How are they linked to each other?

3. **Evaluation:**
   - Is the area seen as attractive? Why? Why not? By whom?
   - Is the area developing or declining? In what ways?
   - Are there current environmental or other “problems” in the area? Which? Where?

4. **Change:**
   - What major changes are foreseen for the region?
   - Are they related to growth or decline?
   - Are the pressures for change being driven from the inside or the outside of the area?
5. Impact:
   Are anticipated changes seen as beneficial or harmful? To whom?
   Are they seen as serious? As irreversible?

6. Decision:
   What is the main purpose of the geodesign study? Public action? Economic profit? Scientific advancement?
   Who are the major stakeholders? Are they public or private?
   Are “positions” known? Are they in conflict?
   Are there legal and implementation-related aspects that must be considered?
   Are there any binding limitations that must guide the activities of the geodesign study?

   In any geodesign study, choices must be discussed and decisions made in order to narrow and define the scope of the geodesign application, define its methods and carry them out to a favorable decision. This is the primary focus of the first iteration through the framework.

The second iteration: The HOW questions

The aim of the second iteration is to choose and clearly define the methods of the study, the HOW questions. In this stage, the framework is used in reverse order, working from question 6 to question 1 (figure 3.3). This reversal of the regular sequence of conducting a study is crucial to designing a set of potentially useful methods. In this way, geodesign becomes decision-driven rather than data-driven.

**Figure 3.3:** The second iteration, the HOW questions. In this iteration, the six primary questions are asked in reverse numerical order, from 6 to 1, as indicated by the green arrows moving upward. The answers to this round of questions provide the geodesign team with an agreed-upon methodology for the study. | Source: Carl Steinitz.
Some typical questions that might be posed during this second iteration include the following:

6. Decision:
   How will decisions be made? By whom?
   What do the decision makers need to know?
   What are their bases of evaluation? Scientific evaluations?
   Cultural norms? Legal standards? Are there issues of implementation such as cost, phasing, and choice of technology?
   Are there issues of public communication? Of visualization?

5. Impact:
   Which impacts of possible changes are most important?
   Which impacts must be must be assessed by law or regulations?
   How complex must the impact assessment be?
   How much, where, when, and to whom are these seen as “good” or “bad”?

4. Change:
   Who defines the assumptions and requirements for change?
   How?
   Which scenarios for change are selected? Toward which time horizon(s)? At what scale(s)?
   Which issues are beyond the capabilities of the geodesign team and study models?
   Which change model(s) are to be applied? Are the outcomes to be designed, or simulated, or both?

3. Evaluation:
   What are the measures of evaluation? In ecology? In economics? In politics? In peoples’ visual preferences?

2. Process:
   Which process models should be included?
   How complex should the models be?
   At what scale(s) should they operate?
   At what time horizon(s)?

1. Representation:
   Where—exactly—is the study area? How is it bounded (and why?)
   Which data are needed? For which geography? At what scale? At which classification? For which times?
   From what sources? At what cost? In which mode of representation?

Designing the methodology for a geodesign study involves complex decisions, often drawing on the experience and judgment of the entire geodesign team. Understanding how public and private decisions to alter or conserve the landscape are made within that geodesign context is a basic element of a geodesign methodology. The requirements for the study must be understood and ranked in importance. The geodesign team must specify the impacts that the decision makers and their constituents will consider. Using their professional and scientific expertise, the geodesign team will need to consider the several ways of designing, and decide in which way they will achieve and propose strategies for change. They decide how to assess evaluations of existing conditions and investigate the structural and functional processes of the study area, and they then specifying appropriate models and their data needs. Only then can the team identify requirements for data acquisition and appropriate means of representation.

In addition to the six questions within the framework, I have also found these additional overarching questions relevant to making methods choices for any kind of geodesign study. While these questions are not explicitly part of the framework I have been describing, their answers provide additional information that a geodesign team will need to do its best work.

- Who should participate and how? Local residents? Political leaders? Corporate directors? Outside experts?
- What are the tradeoffs between faster results and rapid action versus possibly better research but delayed decisions?
- Will the study end with a single “product” or will it develop a continuing decision support process?
- What is the appropriate cost of the study? How much time, money, and basic research are needed?
The third iteration: The **WHAT, WHERE, and WHEN** questions

The third iteration through the framework carries out the methodology designed by the geodesign team in the second iteration (figure 3.4). During this round we ask the **WHAT, WHERE, and WHEN** questions as we implement the study and provide results. In this third stage, the framework is again used from top to bottom, from questions 1 to 6, through models of representation, process, evaluation, change, impact, and decision.

During this third iteration of the framework, data become a central concern. We now identify and gather the data necessary for the study, organize them within an appropriate technology, and begin to represent them in a format useful for the study purposes. Once the relevant data are organized for the process models, the models are implemented and the resulting information helps us develop a baseline from which to assess both the existing study area and the impacts of future change. We design and/or simulate a range of alternative future states of the study area and comparatively assess their impacts. Decision makers can then better understand the potential consequences of their decisions and subsequent future changes. Some of the many activities that need to be accomplished during this stage are listed here.

1. **Representation models**
   - Obtain the needed data.
   - Organize them in an appropriate technology.
   - Visualize the data over space and time.
   - Organize them to be shared among the members of the geodesign team.

2. **Process models**
   - Implement, calibrate, and test the process models.
   - Link them to each other as appropriate.
   - Link them to the expected change models.

3. **Evaluation models**
   - Evaluate past and present conditions.
   - Visualize and communicate the results.

4. **Change models**
   - Propose and/or simulate future changes.
   - Represent them (as data).
   - Visualize and communicate them.

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**Figure 3.4**: The third iteration: the **WHAT, WHERE, and WHEN** questions. In this iteration, the questions are again asked in numerical order, from one to six as indicated by the green arrows moving downward in the figure as the geodesign team carries out the study. | Source: Carl Steinitz.
Chapter 3: Questions and iterations

5. Impact models
Assess and compare the impacts of each change model via the process models. Visualize and communicate the results.

6. Decision models
Compare the impacts of the change models and decide:
No, which requires feedback, or
Maybe, which may require further study at a different size or scale, or
Yes, which leads to presentation to the stakeholders for their decision and possible implementation.

Once a geodesign team has worked its way through the three iterations of the framework questions, there can be three possible decisions as an outcome: No, Maybe, or Yes (figure 3.5).

Reaching a No implies that the study result does not satisfy the geodesign team and is not likely to meet the requirements of the decision makers. Then any or all of the six steps are subject to feedback and alteration: we can seek more or better data, an improved process model, altered criteria and re-evaluation, redesign of the proposed changes, mitigation of impacts, and (possibly) education of the decision makers. Plus, at any point in the framework, new inputs of different types and from different sources may be received, leading to a revisiting of decisions. This makes geodesign particularly nonlinear in its application.

If the team’s decision is a Maybe or perhaps a contingent Yes decision, it may also trigger a change in the scale, size, or time frame of the study (figure 3.6). Shifting the scale of the project may lead to either larger or smaller geodesign activities, and the structure and content of several model types may require modifications. Nevertheless, the study will again proceed through the six questions of the framework and continue until the geodesign team achieves a positive (Yes) decision.
If a Yes decision is reached by the geodesign team once the framework has been followed, the resulting study or proposed project is poised for presentation to the stakeholders for their review towards implementation and action (figure 3.7).

Decision making is the responsibility of the region’s stakeholders, from the individual to the highest levels of government. In order to make decisions, questions must be asked and answered, and options for choice must be framed and deliberated. The decision makers (and there may be many layers of decision making) also have the choices of No, Maybe, or Yes (figure 3.8). A No may trigger the end of the study. A Maybe will likely be treated like feedback and require changes in the geodesign methods or their results. A Yes decision implies implementation and updating for future representation models.

Implementation of agreed-upon designs is not necessarily automatic or immediate, especially for larger and longer-term projects. In whatever ways the geography changes (and it may be via continuous geodesign study), there will be forward-in-time changes to new representation models. Future generations are likely to seek changes in their geography and see the implemented consequences of the geodesign team’s study as part of their data, and so the cycle continues for generations of people of that place. All geographies, designed or otherwise, are always in a state of change.

When repeated and linked over scale and time, the questions of the framework may be the organizing basis of a very complex and ongoing study. The result may be a 2-, 3-, or 4-dimensional study, at a range of scales. Regardless of complexity, the same questions are repeated in any future projects. However, the answers, models, methods, and results, and the ways by which they were developed and applied will continue to vary.

Figure 3.7: A Yes decision by the geodesign team implies completion and subsequent presentation to the stakeholders for their review and decision. | Source: Carl Steinitz.

Figure 3.8: Review and a Yes decision may lead to implementation. | Source: Carl Steinitz.
The framework in practice

At first glance, the framework may appear to be excessively linear. Yet while the framework’s questions and models are purposely presented in an orderly and sequential manner, the framework is normally not linear in its application, and the route through any study is not straightforward (figure 3.9). A geodesign team can experience many entry ways into a study, including some idiosyncratic ones. In some cases we may receive inspiration from the place (genius loci), see the solution immediately, or present the client with a preconception. Furthermore, there will always be unanticipated issues, false starts, dead ends, and serendipitous discoveries along the way.

Variations to the framework are best executed by experienced professionals who have developed sophisticated internalized responses to the framework’s questions. In other words, individuality, creativity, and invention in geodesign are most likely to succeed when well prepared for and applied in a clearly organized framework. Paraphrasing the eminent scientist Louis Pasteur (1822–1895), “Fortune favors the prepared mind.”

When designing the methodology for a geodesign study and carrying it forward to a decision, a symbiotic relationship develops between the geographic sciences, the design professions, information technologists, and the stakeholder clients. The degree to which their influences vary depends on which of the six questions is being addressed at that time. Questions 1, 2, and 3 refer mainly to the past and the existing conditions of the study’s particular geographic context. The geographic sciences tend to dominate during this phase in their use of both (1) representation models and (2) process models. It is at this point that factual conditions for geodesign must be established as a baseline for evaluation and as a reference for change. The responsibility for (3) evaluation models is more diffuse. The design professions can provide more local, functional, and sensory understanding that incorporate local cultural knowledge and values.

Questions 4, 5, and 6 of the framework concern the future more than the past and present. Change models (4) will require the greatest contribution from the design professions, largely because of their education and experience in “synthesis.” The geographic sciences have a major role with the impact models (5), which assess the proposed changes. Decision models (6) are ultimately the responsibility of the decision makers but in reality all may participate. Again, one hopes that there is (or was) a shared set of values among the collaborating scientists, designers, information technologists, and the people of the place.

Figure 3.9: In practice and application, the framework for geodesign is never linear. Instead it can be flexible to accommodate the inevitable and unanticipated events that occur during any study. | Source: Carl Steinitz.
I contend that even with the inevitable unanticipated events, a typical geodesign project passes through the three iterations of the six questions of the framework, explicitly or implicitly, at least once before a Yes decision towards implementation can ever be reached. Choosing from the start to deliberately deviate from this type of framework may lead to poor and costly decisions and unhappy stakeholders or clients.

A framework is useful only if it is seen to be useful by those who work with it. This framework can be a valuable aid to the organization of large and complex geodesign problems. It has been used by me and others in professional practice, academic studies, academic and professional workshops, and in organizing and carrying out large, applied research programs. Some of these are described in the case studies later in this book.

Notes

   Revised version in GIS Europe 2 (1993): 42–45
   Revised version in Planning (2000). (Chinese.)

2. Louis Pasteur, Lecture, University of Lille, December 7, 1854.