Chapter 2
Which Way of Designing?

Carl Steinitz

2.1 Introduction

> Everyone designs who devises courses of action aimed at changing existing situations into preferred ones. (Herbert Simon, The Sciences of the Artificial, 1969)

I have organized many collaborative, multidisciplinary studies of major landscape change over more than 40 years at Harvard and in collaboration with other universities. The framework within which I organize most of my work and teaching strategies has been published in my recent book A Framework for Geodesign (Steinitz 2012). In this paper I will focus on one of the most significant decisions which the geodesign team must make when organizing the methods for its study: Which of the change models—which of the many ways of designing—shall we use? The change model which is selected may be the most important part of any professional or academic project because if the methods are unsatisfactory, then the products are also likely to be unsatisfactory.

2.2 The Framework for Geodesign

The framework for geodesign consists of six questions that are asked (explicitly or implicitly) at least three times during the course of any geodesign study. They all 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.

C. Steinitz (✉)
Harvard Graduate School of Design,
Harvard University, Cambridge, MA, USA
e-mail: csteinitz@gsd.harvard.edu

D. J. Lee et al. (eds.), *Geodesign by Integrating Design and Geospatial Sciences,*
GeoJournal Library 1, DOI 10.1007/978-3-319-08299-8_2

These six 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 knowledge about the study context.
3. Is the current study area working well? This question is answered by *evaluation models*, which are dependent upon the values 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 generate data that will be used to represent future conditions.
5. What difference might the changes cause? This question is answered by *impact models*, which are knowledge 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 values of the responsible decision makers.

Questions 1–3 refer mainly to the past and the existing conditions of the study's particular geographic context. They focus on assessment. Questions 4–6 of the framework concern the future rather than the past and present. They focus on intervention.

Over the course of a geodesign study, each of these six primary questions and their subsidiary questions are asked at least three times (Fig. 2.1). In the first iteration the questions are asked beginning with question 1 as we define the context and scope of the work. In this first iteration we treat these as WHY questions for the project. 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. 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. The third iteration carries out the methodology designed by the geodesign team in the second iteration. 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 from questions 1–6, through models of representation, process, evaluation, change, impact, and decision. 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".

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. 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. Shifting the scale of the project may lead to either larger or

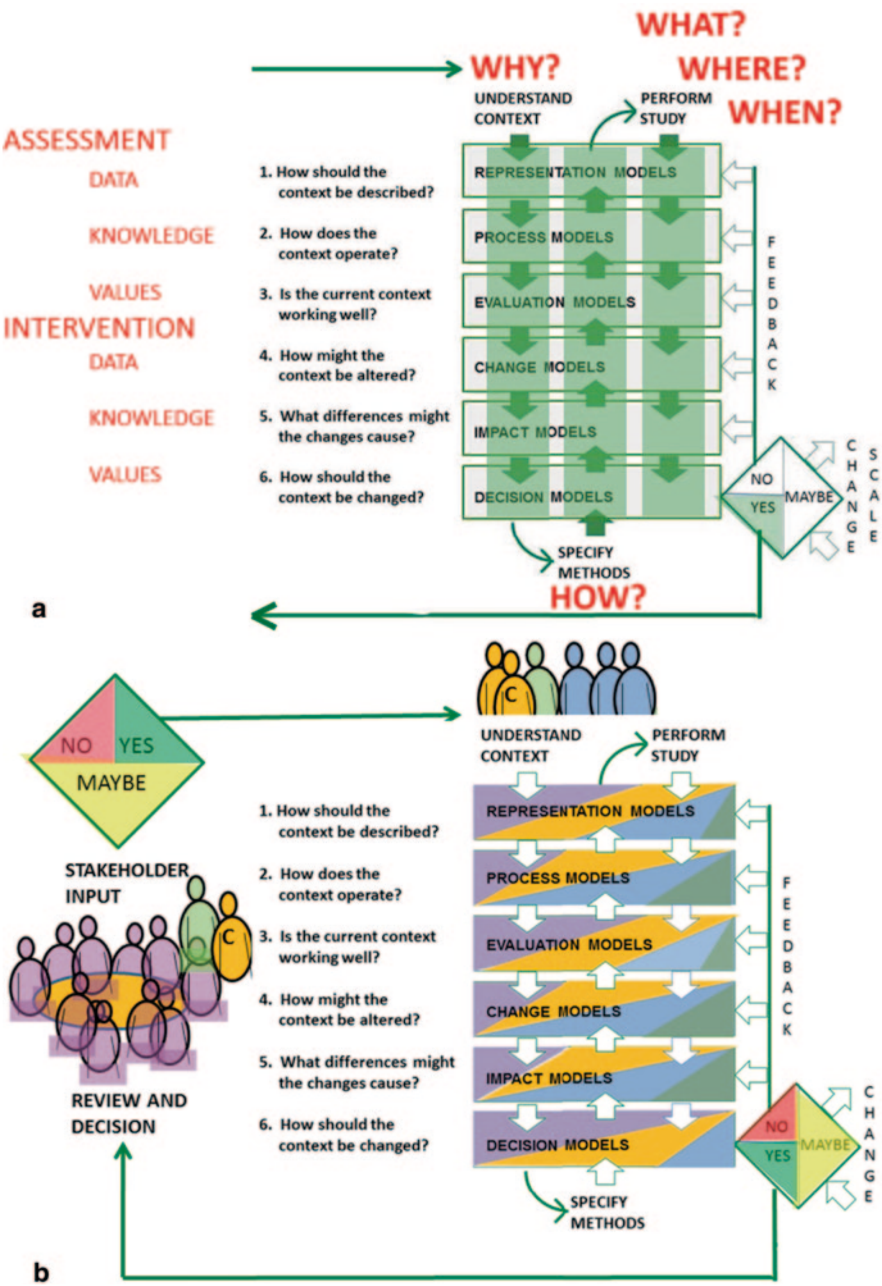

Fig. 2.1 The framework for geodesign

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, the resulting study or proposed project is poised for presentation to the stakeholders for their review towards implementation. The decision makers (and there may be many layers of decision making) also have the choices of "No," "Maybe," or "Yes". 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, 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 geography, designed or otherwise, is always in a state of change.

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 straight forward. There will always be unanticipated issues, false starts, dead ends, and serendipitous discoveries along the way.

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, and at a range of scales. Regardless of complexity, the same questions are repeated in any applications of geodesign. However, the answers, models, methods, and results, and the ways by which they were developed and applied will vary according to the case under study.

It is important to emphasize that geodesign (indeed, any design) 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.

2.3 Change Models: Ways of Designing

> Many devices which succeed on a small scale do not work on a large scale. (Galileo Galilei, Discorsi e dimostrazioni matematiche, intorno à due nuove scienze, 1638.)

The basic problem of geodesign can be stated as, "How do we get from the present state of this geographical study area to the best possible future?" In the framework we answer the question: "How might the landscape be altered?" with change models, the ways of designing and achieving the products of the geodesign study. The relative influences of the methodological choices made in the second iteration of the framework will not be equal, and change models are a particularly important element within the geodesign framework. There are multiple strategies for approaching change models. In the book I describe eight different ways of designing for change and a ninth mixed example.

All change models combine decisions related to allocation, organization, and expression, and all require visualization and communication (Fig. 2.2). Allocation refers to where changes are located, such as the placement of new housing in the landscape, the conversion of forest to agriculture, or the protection of a rare animal's habitat, and so on. Organization refers to the interrelationships among the elements of the design, such as how the school, the shopping area, the park, the bus system, and both low- and high-density housing all fit together in the design of the new community. Expression refers to the way in which the design is perceived. For example, is it seen as a residential community, or as a friendly place, a beautiful or an expensive one, etc.

These three characteristics of allocation, organization, and expression are rarely applied with equal emphasis in change models. As a general rule, the larger the size of the design study, the more emphasis is placed on allocation. By contrast, the smaller the project, the more emphasis can be placed on expression. This change of emphasis is characteristic of the differences between landscape planning and garden design, or regional planning and architectural design, or demography and being a parent.

I think that the extremes of size and scale are relatively well served. Design professionals such as architects, landscape architects, urban planners and civil engineers are generally capable at serving client needs at the scales which are symbolized in Fig. 2.2 by the house and the urban design. They increasingly work

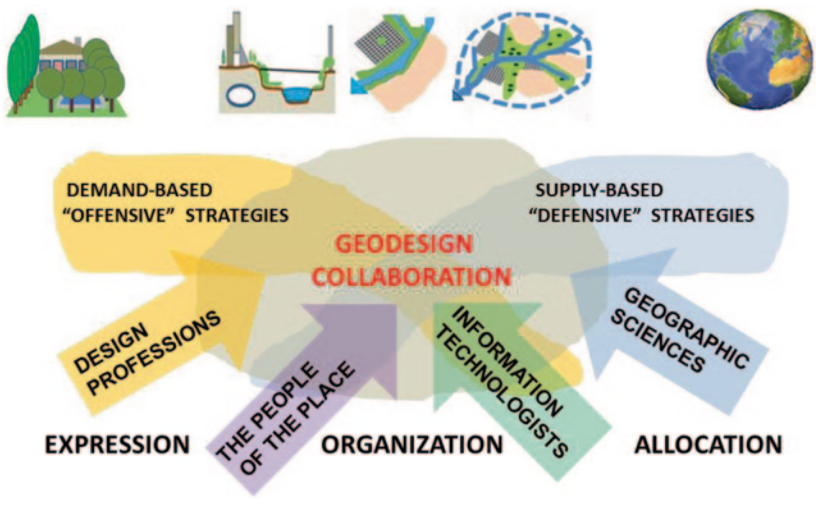

Fig. 2.2 Influences of size and scale

with the people of the place, and on rare occasion with geographic scientists. Similarly geographically oriented scientists are generally capable of understanding the needs of the environment at the scales symbolized from the globe to the large region. They increasingly work with information technologies, and on rare occasion with design professionals. I believe that collaboration in geodesign can be most significant and effective where the extremes overlap, between the large project and the large region. This requires the participation of all four groups: design professionals, geographic scientists, people of the place and information technologies. This range of geodesign "problems" is where the decisions that can really shape the world's environments (plural) for the better are and should be made.

Regardless of size or scale, every geodesign study has four groups of influences which should be considered: the history of the place and its past designs and proposals, the "facts" of the area which are not likely to be changed during the period of study, the "constants" which should be incorporated into any proposed alternative, and the requirements of the project. Yet, while all change models are different they share the same overarching template (Fig. 2.3). The parallelograms can best be understood as map layers of spatial representations needed for the geodesign study, such as drawn diagrams or data layers within a GIS. The arrows are the links in the cumulative process of making the design.

The first influence is history. Knowing the history of the geographical context within which the geodesign study will occur is essential, particularly the history of any previous designs for that area. In my long experience, I have never worked in a region that didn't already have past designs, and the people who made them were not fools.

Next are facts. Facts are aspects of the geography that are assumed not to change over the life of the design. These can be aspects or results of the study's representation, process or evaluation models. We might be working toward a point in time 20 or 30 years in the future, and such things as subsurface geology or a major river pattern or the evaluation of an historic palace are not likely to change within that time frame.

Then there are constants, the things that are certain to occur in the time-frame of the geodesign study. You must find out about them, because if you don't, none of your alternatives will be implemented. An example of a constant could be a high-

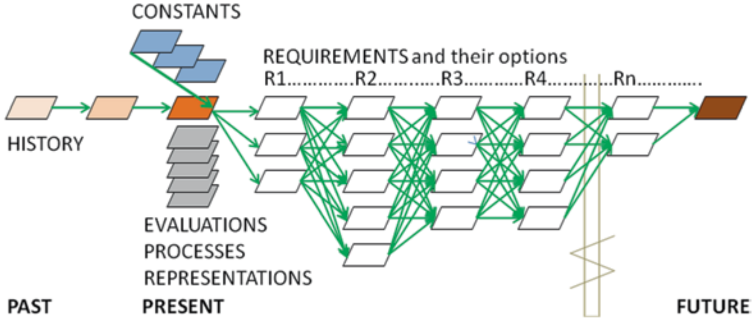

Fig. 2.3 The template for change models

way or sewage treatment system in the study area which has already been proposed, approved, designed, funded, and though not yet constructed, is contracted to begin within the next year or two.

Lastly, there are the requirements and their options, the things that should and could happen. Capturing the major, strategic, and generating requirements and their alternative choices is key here. The most important assumptions must be part of the beginning of the sequence of change-decisions, since if you make the first steps wrongly, you will certainly end up wrong. Then again, if you make the right first steps you still may end up wrong, but you have a better chance of success. Spatial analysis frequently plays its most critical role in the assessment of these initial and strategic alternative choices. You have to be able to say: "either here, here, or here," or "in one or more of these several ways."

Each of the eight change models and one mixed example shown in Fig. 2.4 represents a different strategy for approaching and organizing the design and/or simulation of change. (Each is described in Part III of my 2012 book with a case study of major landscape change as applied within the framework for geodesign.) The names of each of these change model strategies reflect their primary approach or characteristic: anticipatory, participatory, sequential, constraining, combinatorial, rule-based, optimized, and agent-based. All eight support the use of scenarios, recognizing that there are an infinite number of future options. At the same time, all of them eventually reduce the possible number of alternatives from the infinite to a manageable number. In the end, the change models must include the most important issues and produce an appropriate range of policy and design choices. Although nearly all designs are the result of combinations of these eight ways, during a given geodesign project one of these eight is likely to dominate. The way that the change model is organized and started is crucial and should be preplanned in the second iteration of the framework for geodesign.

The change models can be considered in three different groups. The anticipatory, participatory and sequential change models assume that the designer or the geodesign team is confident in the ability to directly develop the design for the future state of the study area. The constraining and combinatorial ways assume that the geodesign team is not certain of the crucial initial decisions and must first assess the major requirement-variables before developing the rest of the design. The rule-based, optimized, and agent-based approaches assume that the geodesign team is assumed to understand the rules that guide the processes of change, but also is obligated to test the variability of the main requirements in order to develop the most beneficial design solution.

Well before writing the book I had often argued that there is no such singular thing as "THE Design Method" or "THE Planning Method" (and I consider a plan to be a design). Rather, there are many methods and they must be chosen in the second iteration of the framework and adapted to issues and questions raised by the problem at hand. This raised the important but difficult question: Which way of designing should be chosen? My hypothesis was that the larger and more complex geodesign studies would be best served by the more complex change models (Fig. 2.5).

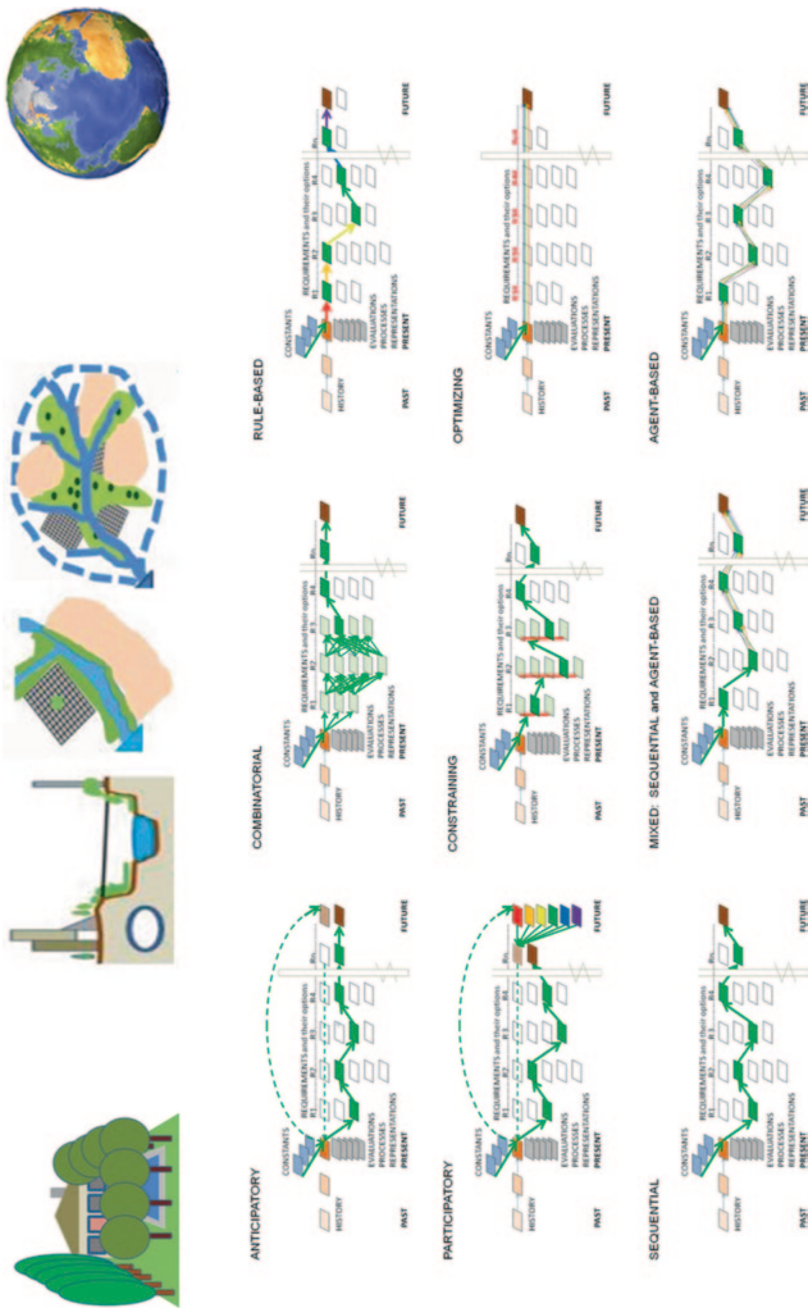

Fig. 2.4 Change models: ways of designing

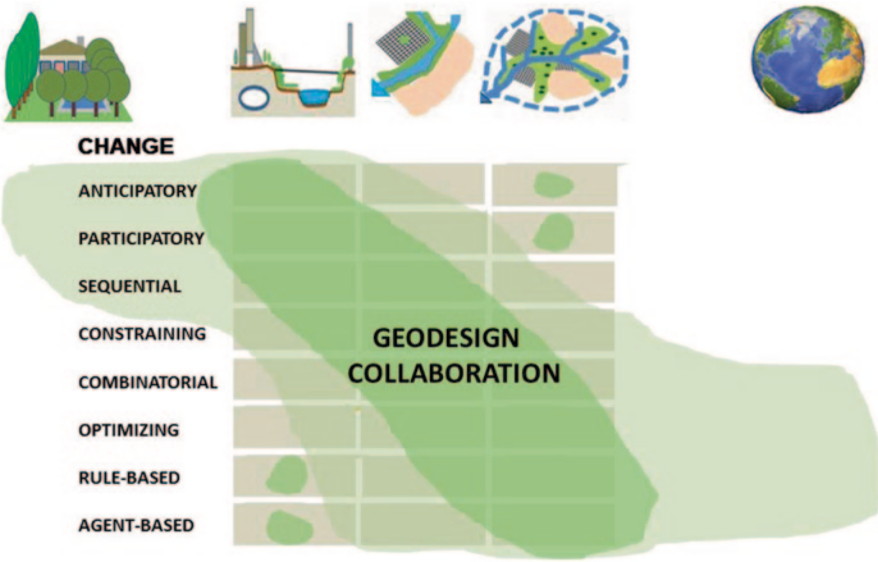

Fig. 2.5 An hypothesis regarding the link between geodesign size and scale, and the efficacy of change models

2.4 The Redlands Experiment

At the first Geodesign Summit in Redlands California in 2010, I proposed an initial experiment to test and compare the efficacy of the nine change models described in my book. This idea was taken up by Jack Dangermond and several other persons, some of whom I had previously worked with. With significant support from Jack and ESRI, an agreement was made with the City of Redlands and the University of Redlands to conduct an experimental workshop that would be of help to the city regarding two prominent issues facing it. The first was the preparation of a landscape plan for the city (which Redlands referred to as an open space plan). This was seen as 2-dimensional design. The other was the 3-dimensional design for a transit-oriented development near ESRI's corporate campus (Fig. 2.6).

In this agreement, the Redlands University and its Redlands Institute would host the workshop and have several faculty and some students as participants, the City of Redlands would organize the data and its representation, process and evaluation models, and establish all the requirements for the two geodesign studies. Its planning staff and several residents who are active in city affairs would be participants. ESRI would contribute several information-technology staff, and allow the workshop to test several geodesign management tools which were in early development. I would help recruit persons who were familiar with the framework and who would organize the work of the geodesign teams, and I would manage the workshop (with a lot of help).

The core team and several persons from Redlands met in October 2010 to plan the workshop and its information flows. There were three significant constraints: the work-

Fig. 2.6 The study areas

shop had to be conducted within five consecutive days, it had to be based on existing and pre-available public data, and we needed to have as much of a controlled experiment as possible. We recognized and discussed many other potential limitations: short preparation time, active-time for the workshop and for software pretesting, the workshop's time schedule, the varied skills among participants, the possibility of wrong or too narrowly or broadly defined models (and especially for qualitative aspects), and that the two geodesign problems were not really "real", for either Redlands' Open Space or the anticipated Transit Oriented Development (TOD).

The workshop was held from January 10 through 14, 2011. There were about 50 people as full time participants and several observers. The schedule for the five-day workshop was basically as follows: Monday was for orientation lectures which were prepared by the city of Redlands, and a site visit throughout the city and to the area of the proposed transit oriented development. It also included an overview lecture on the framework and the several change models, and the organization of the participants into the nine multidisciplinary geodesign teams. Each team would have at least one person with geodesign experience, one with information-technology skills, one resident of Redlands, and one with relevant knowledge from the arts and/or sciences. Tuesday, Wednesday and Thursday were to be devoted to preparing the two designs. Each team was encouraged to make its initial open space design first. Tasks would be organized as each team decided so long as it was as possible within the change model to which it was assigned. Friday morning was for preparing a public presentation of the team's way(s) of designing, and the products of its geodesign activities. On Friday afternoon a public presentation was made in the largest auditorium at ESRI to a capacity audience.

The flow of information (Fig. 2.7) was designed so that each geodesign team would have maximum flexibility in using the representation, process and evaluation models which had been prepared by the City of Redlands. In addition, each team would have access to three assessment dashboards. The first provided immediate feedback on whether any new element of the design was moving toward or away from the program requirements established by the city. The second provided immediate feedback on whether any new element of a design was improving or diminishing vis-à-vis the criteria of the city's decision model for each of the two designs. A third information management dashboard allowed all participants to compare the performance across the nine teams for each of the two geodesign problems.

The City of Redlands planning office and several resident—participants had organized the program for each of the two designs, and all aspects of the models needed for the assessment phase (Fig. 2.8). These were to be assumed as correct and sufficient by all the workshop's participants

On the first day of the workshop and after an orientation to the open space plan and the TOD, those participants who were residents of Redlands participated in a two-stage Delphi experiment in which they were asked to weight the several criteria established by the City of Redlands for each of the two geodesign problems. This experiment was aimed at identifying the decision models which would guide the final comparison of the designs and the assessment of the efficacy of the various change models.

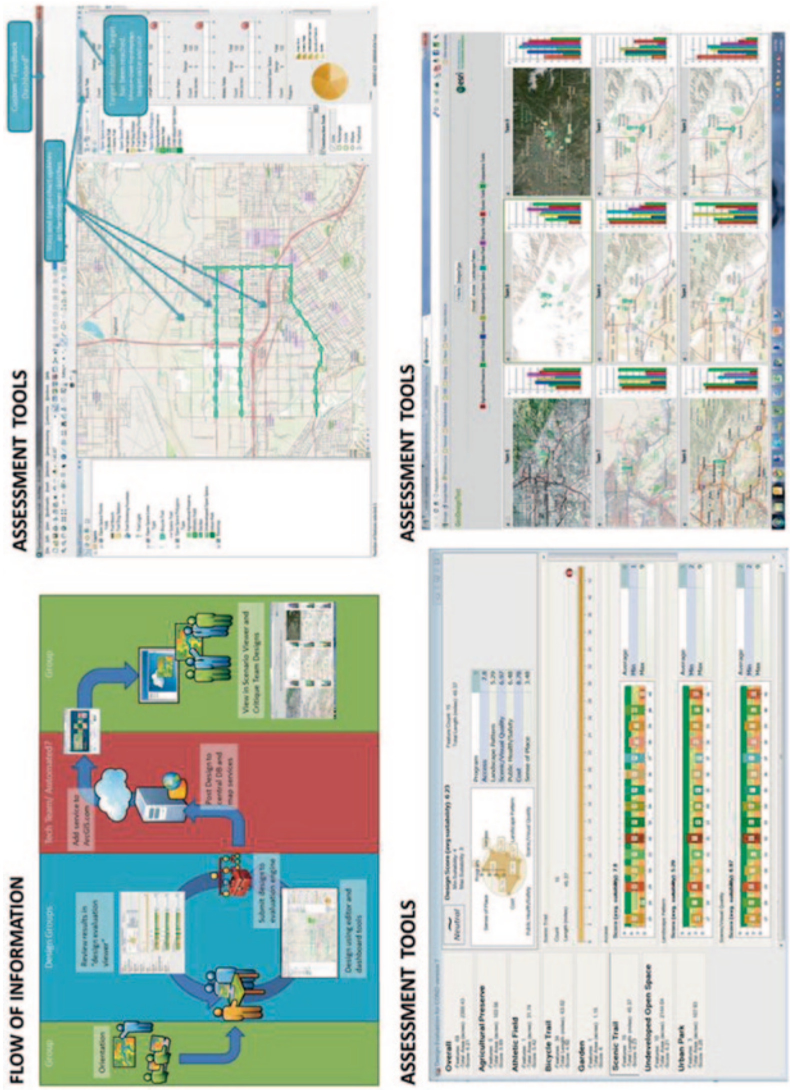

Fig. 2.7 The flow of information and the assessment tools

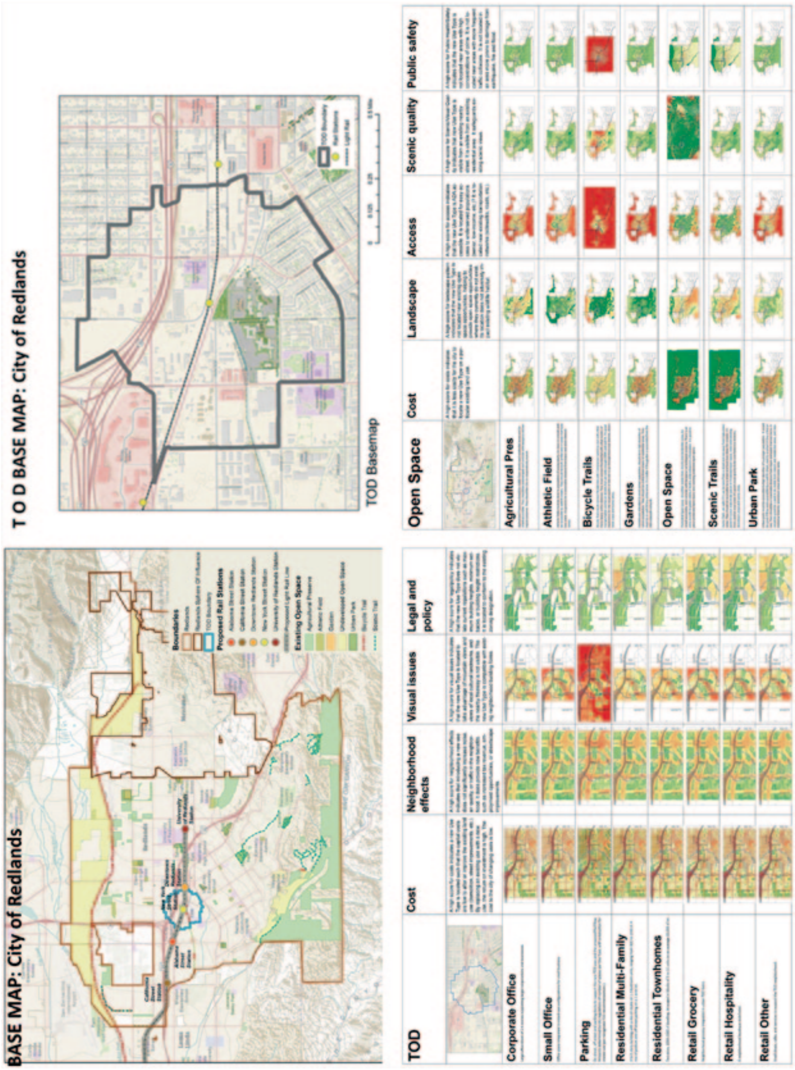

Fig. 2.8 Representation, process and evaluation models, and their resulting impact models

2.5 Anticipatory

The anticipatory approach is based on the premise that the designer's confidence and experience can provide the "great leap forward" to a concept of what might be the basis for a good design (Fig. 2.9). This necessarily assumes that the designer has a sufficient and adequate amount of experience from which to draw upon. He or she will then need to go back to existing conditions, and through deductive logic move forward through the many requirements and their options to try to achieve the preconceived design.

The anticipatory team had two participants who were very experienced professionals in design at the scales and types of the two workshop cases. The team decided that each of these persons would work as an individual designer, with the rest

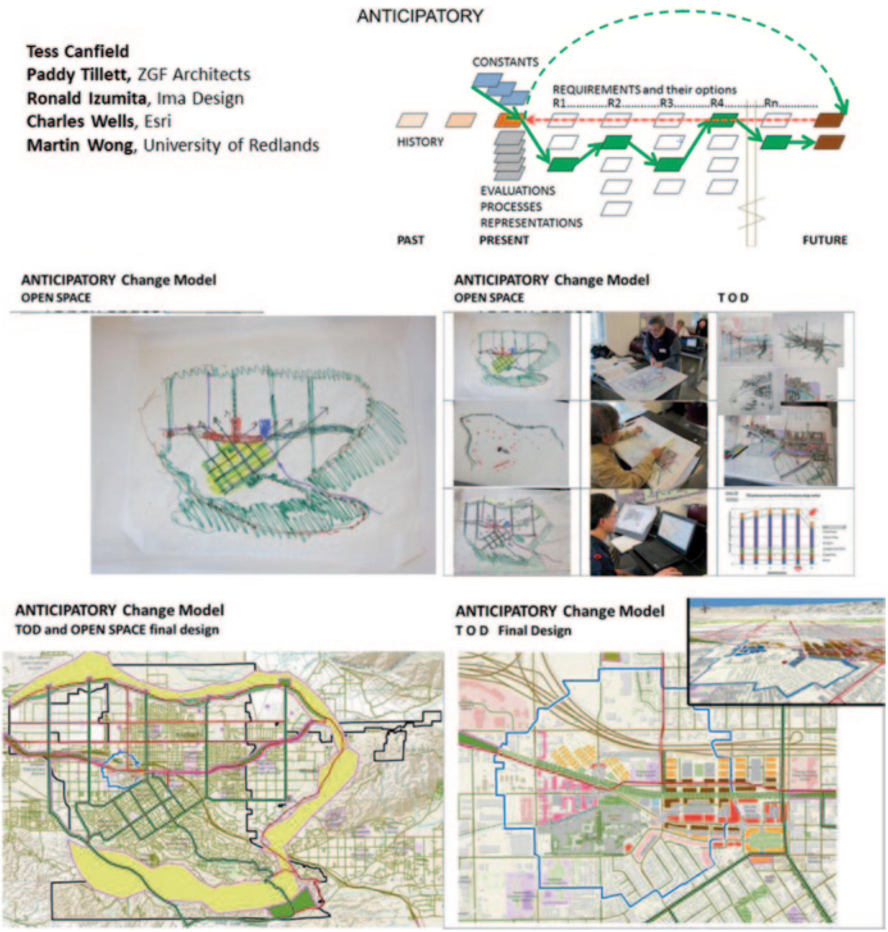

Fig. 2.9 The anticipatory change model

of the team in support of their needs as they developed. Both designers chose to work by hand-drawing on paper through several iterations of their initial conceptual diagrams, while other members of the team prepared staged digital versions for the several available impact assessments. The better-performing designs of one of the two designers is shown in Fig. 2.9.

2.6 Participatory

The participatory design approach assumes that there is more than one participating designer, and that each has a concept about what the future design should be (Fig. 2.10). This premise expects the designers to have a sufficient

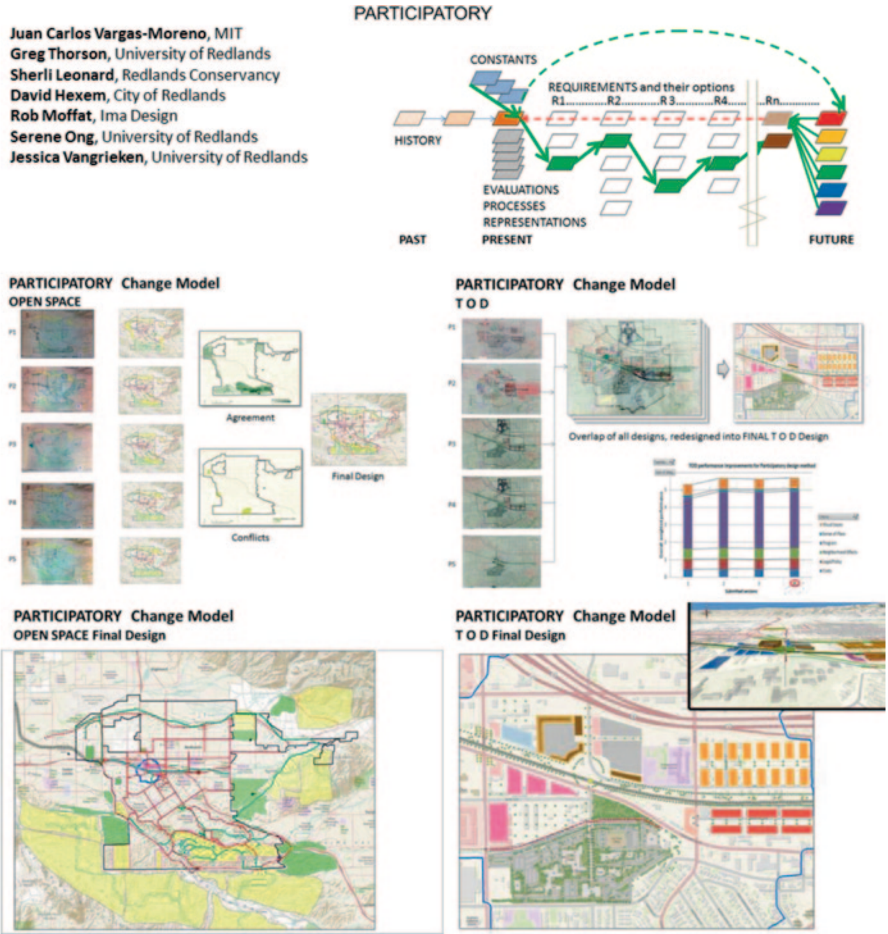

Fig. 2.10 The participatory change model

sense of place and time to provide a future-oriented design, while still recognizing that their designs are different and must be aggregated into one consensus design.

Five members of this team were residents of Redlands and they were chosen as the direct participants. Each person drew a design for the open space system. These were digitized and algorithmically compared for their spatial agreement. The final plan is the result of a series of majority—decision rules combined with a modest amount of interpersonal negotiation based on expert local knowledge. A similar strategy was applied for the TOD, but in this case the five initial drawn designs were negotiated into a first consensus. This design was then digitized and improved through a series of feedback loops to what was the final design.

2.7 Sequential

Under the sequential approach, the designer makes a series of confident choices that systematically develop into the future design (Fig. 2.11). This approach begins with present conditions and uses abductive logic as it moves with certainty directly through a single set of choices for each requirement.

This geodesign team consisted of several residents of Redlands, one of whom was experienced in design at these scales. After a group discussion in which the sequence of decisions was established and various options were given priority, the constraints for the open space design were identified digitally. The design was then rapidly generated manually and its final version made digital. A similar process was followed for the TOD, but in this case an early version was digitized and improved through feedback to its final state.

2.8 Constraining

The constraining method (Fig. 2.12) is useful when the client and/or the geodesign team are not sure of the decision models, or when the relative importance of the study's objectives or requirements approximate Zipf's Law but where there are also many options for each requirement. A strategy of making decisions by comparing and selecting options in the sequence rank order of decision importance is then followed.

This team recognized that the two decision models provided by the Redlands residents generally followed a Zipf distribution. They therefore adopted a strategy of making decisions in the rank order of importance within each decision model. Knowing the sequence made discussions highly efficient and several digital feedback iterations were conducted. The team to follow a similar process for the TOD but in this case the entire design was conducted in a series of hand drawings due to perceived time limitations.

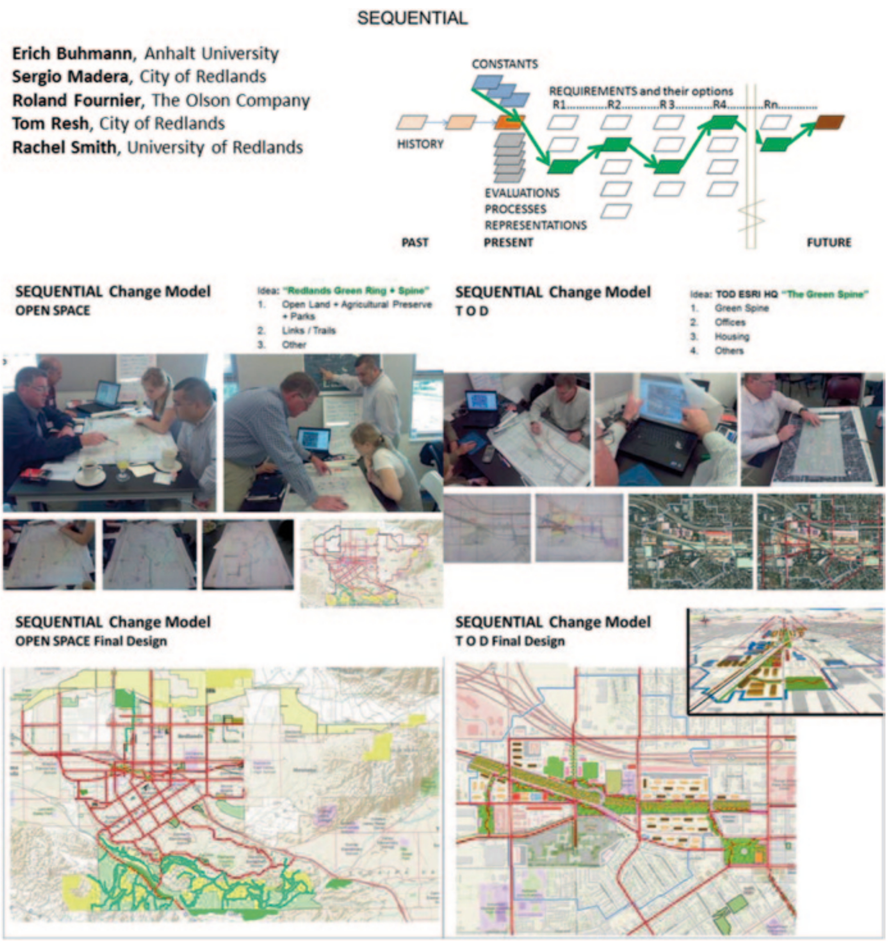

Fig. 2.11 The sequential change model

2.9 Combinatorial

When the designer or the client is not sure of the appropriate choices in the sequence of decisions to create the design, the combinatorial approach is useful (Fig. 2.13). This strategy is commonly applied to investigate alternative scenarios for the future. It is especially appropriate when the few main objectives are of similar importance and a combination of the key requirements must be resolved before continuing with less important ones

This team realized that if they identified the best combination of options for the three most important requirements for each design, and spent less time and energy on less significant requirements, that their final designs had a high likelihood of

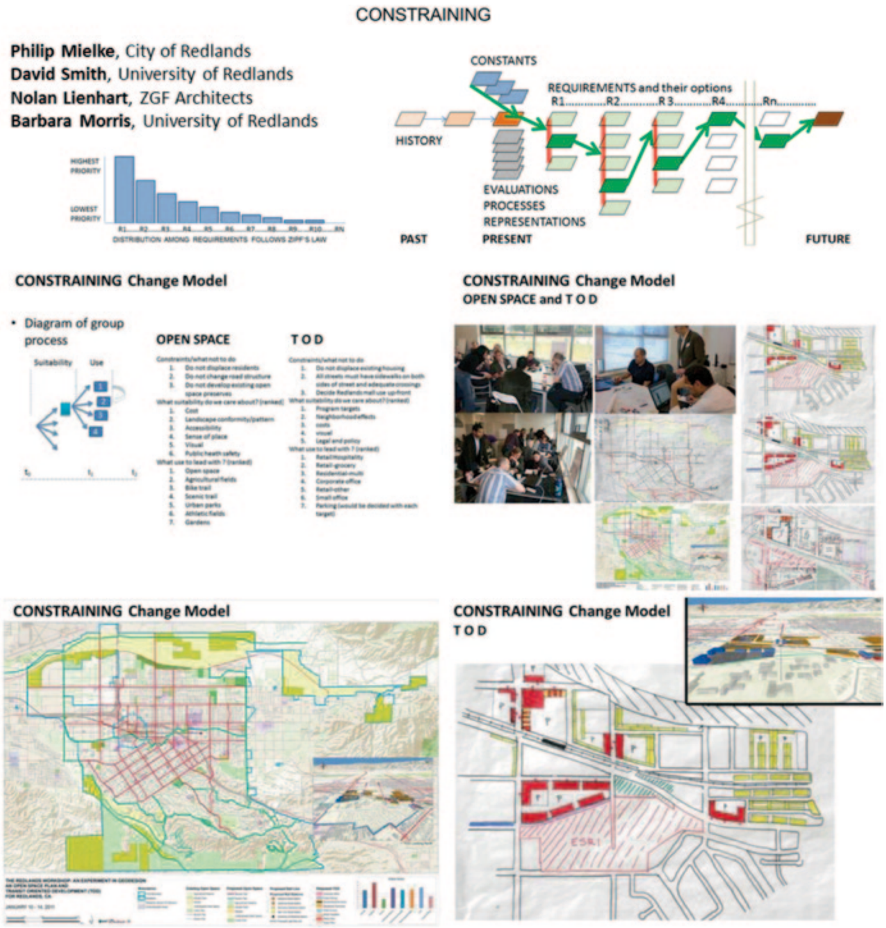

Fig. 2.12 The constraining change model

being good ones. Their first steps were to diagram and name a substantial number of options for the three most significant open space requirements. In a very efficient way, the members of the team sorted and rejected most of the combinations. A decision was made from a short list of feasible sets, digitized and improved through feedback. The same process was then applied to the TOD.

2.10 Rule-based

The rule-based approach assumes that the geodesign team is knowledgeable and confident enough to specify a set of formal rules for developing the design (Fig. 2.14). Such approaches are normally organized as a set of computer algorithms, but they

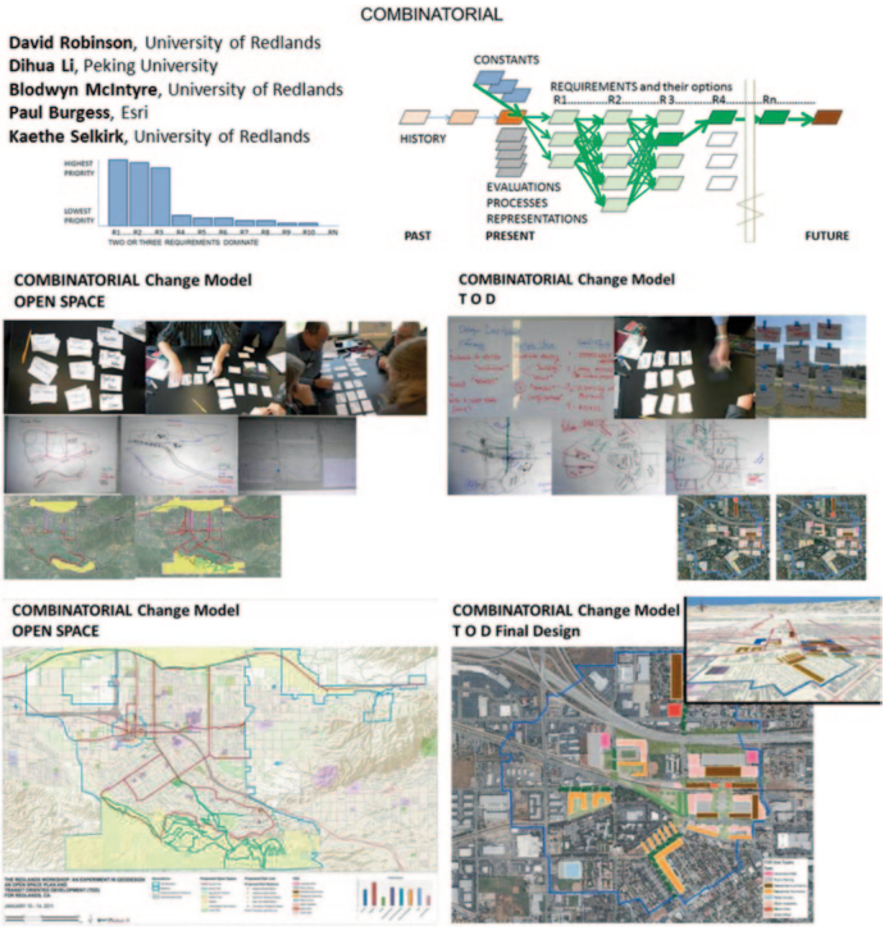

Fig. 2.13 The combinatorial change model

can also be expressed as mental steps which can be followed manually. The rules for each requirement are combined in a sequence of design decisions comparable to that in a sequential approach.

This team decided to build a rule-based model which would allocate the requirements for the open space plan in a sequence of decisions reflecting perceived importance. They were able to do this in an efficient manner, but calibration of distance related criteria required trial and error feedback within the process and evaluation models. Preparing a rule-based model for the 3-dimensional TOD was seen as requiring more time than available, so the anticipatory team's TOD design was borrowed and adapted to the open space plan.

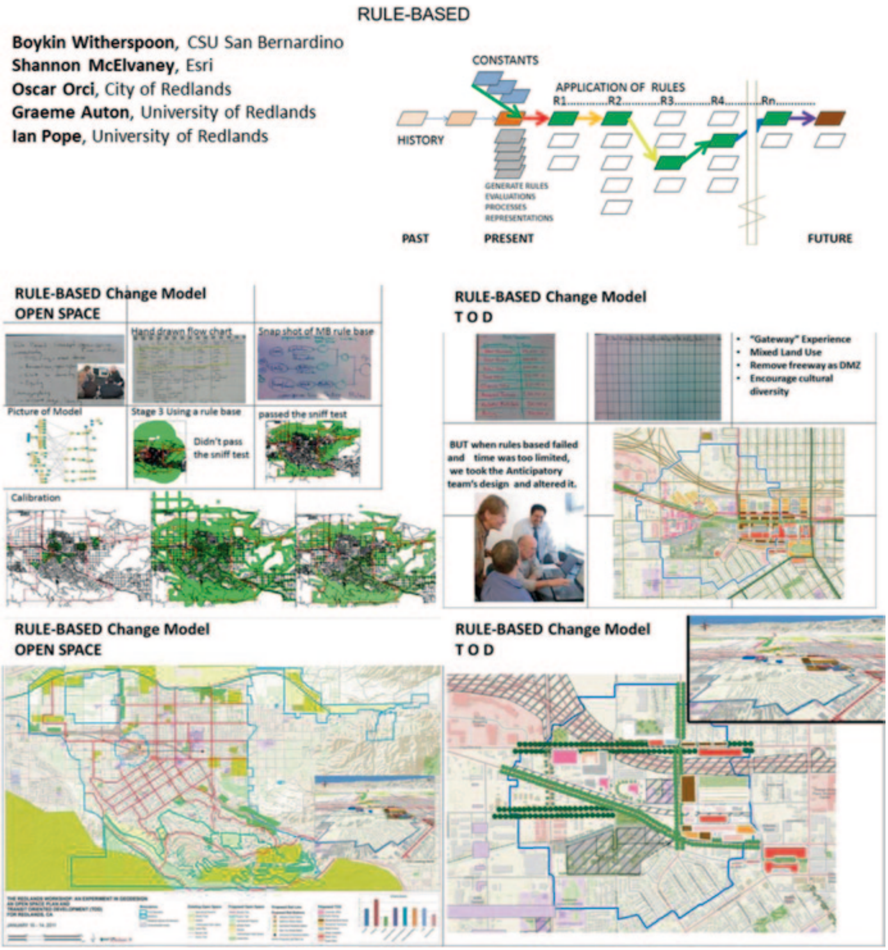

Fig. 2.14 The rule-based change model, with each colored arrow in the diagram representing a different requirement, in this case a different land use

2.11 Optimized

The optimized requires that the client and the geodesign team understand a-priori the relative importance of each of the desired requirements and also its decision criteria. The optimizing decision model is based on the values of the decision makers and reflects their goals, the values by which they make judgments about the design, and the relative importance they attach to these goals and values. This approach needs these criteria to be identified and comparable in a single metric, such as a financial rate-of-return or potential votes, etc., in order to be able to declare a design "optimal" in the end (Fig. 2.15).

http://www.springer.com/978-3-319-08298-1

Geodesign by Integrating Design and Geospatial
Sciences
Lee, D.; Dias, E.; Scholten, H.J. (Eds.)
2014, XIII, 369 p., Hardcover
ISBN: 978-3-319-08298-1