

## Chapter 2

# Definitional Test of Complex Systems

Created for the current study, the Definitional Test of Complex Systems (DTCS) is our attempt at an exhaustive tool for determining the extent to which a complex system's definition fits a topic. The DTCS is not, however, a standardized instrument. As such, we have not normed or validated it. Instead, it is a conceptual tool meant to move scholars toward empirically-driven, synthetic definitions of complex systems. To do so, the DTCS walks scholars through a nine-question, four-step process of review, method, analysis, and results—see Table 2.1.

Following Gatrell, the DTCS does not seek to determine if a particular case fits a definition; instead, it seeks to determine if a definition fits a particular case. As Gatrell explains [30], the challenge in the current literature is not whether places are complex systems; as it would be hard to prove them otherwise. Instead, the question is: how do we define the complexity of a place? And, does such a definition yield new insights? Given this focus, Question 9 of the DTCS functions as its negative test, focusing on three related issues: the degree to which a definition (a) is being forced or incorrectly used; (b) is not a real empirical improvement over conventional theory or method; or (c) leads to incorrect results or to ideas already known by another name. Scholars can modify or further validate the DTCS to examine its further utility. Let us briefly review the steps of the DTCS:

Step 1: To answer the DTCS's initial five questions, researchers must comb through their topic's literature to determine if and how it has been theorized as a complex system. If such a literature does exist, the goal is to organize the chosen definition of a complex system into its set of key characteristics: self-organizing, path dependent, nonlinear, agent-based, etc. For example, if our review of the community health science literature, we identified nine characteristics. If no such literature exists, or if the researchers choose to examine a different definition, they must explain how and why they chose their particular definition and its set of characteristics, including addressing epistemological issues related to translating or transporting the definition from one field to another.

Step 2: Next, to answer the DTCS's sixth question, researchers must decide how they will define and measure a definition and its key characteristics. For example, does the literature conceptualize nonlinearity in metaphorical or literal terms? And, if measured literally, how will nonlinearity be operationalized? Once these decisions

**Table 2.1** Definitional test of complex systems (DTCS)

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**Step 1: Literature review and formulation of the definition**

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Question Set 1: What definition of a complex social system will be used?

1. What is the definition?
  - a. For example, is the definition dictionary in form or encyclopedic?
  - b. What are its key characteristics?
2. Where does the definition come from?
  - a. For example, is the definition currently used in the field, or is it a new definition?
3. What are the definition's epistemological assumptions?
  - a. For example, is it postmodern, critical realist, naïve realist, constructionist, etc?
4. What is the theoretical basis for the definition?
  - a. For example, is the definition meant to be metaphorical, literal or prescriptive or some combination?
5. Does the definition or any of its key characteristics seem to be empirically or theoretically problematic?
  - a. For example, are there examples in the literature where usage of the definition led to (i) poorly designed studies, (ii) faulty empirical results, or (iii) flawed or unclear theoretical conclusions?

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**Step 2: Methods**

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Question Set 2: How will the definition be operationalized and tested?

6. How will the current test be conducted?
  - a. For example, what measures will be used?
  - b. What case study will be used?
  - c. What analytic techniques will be used for the test?

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**Step 3: Run test**

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**Step 4: Determine results**

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Question Set 3: What conclusions about the validity and value of the definition were determined?

7. Did the test suggest that the definition is empirically valid?
  8. Did the test suggest that the definition is theoretically valuable?
  9. In terms of the DTCS's negative hypothesis:
    - a. Did the definition or any of its key characteristics lead the test to faulty empirical results?
    - b. Did the definition or any of its key characteristics lead the test to flawed theoretical conclusions?
    - c. Does the definition obey Occam's razor; or is it a lot of work for little empirical or theoretical yield?
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are made, researchers must decide which methods to use. As we have already highlighted, choosing a methodological framework and its associates set of methods is no easy task. So, social scientists are faced with a major challenge: the DTCS requires them to test the validity of their definitions of a complex system, but such testing necessitate them to employ a new methodology, which many are not equipped to use. It is because of this challenge that, for the current project, we employed the

SACS Toolkit, which we discuss next. First, however, we need to address the final two steps of the DTCS.

Step 3: Once questions 1 through 6 have been answered, the next step is to actually conduct the test. The goal here is to evaluate the empirical validity of each of a definition's characteristics, along with the definition as a whole. In other words, along with determining the validity of each characteristic, it must be determined if the characteristics fit together. Having made that point, we recognize that not all complexity theories (particularly metaphorical ones) seek to provide comprehensive definitions; opting instead to outline the conditions and challenges, for example, that educational administrators face when coming to terms with the complexity of their organizations [51]. Nonetheless, regardless of the definition used, its criteria need to be met.

Step 4: Finally, with the analysis complete, researchers need to make their final assessment. To do so, the follow question needs to be asked: In terms of the negative test found in question 9 and the null hypothesis of the DTCS, to what extent, and in what ways is (or is not) the chosen definition, along with its list of characteristics, empirically valid and theoretically valuable? With the answer to this question determined, the test is complete.



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