SDA Bocconi
SCHOOL OF MANAGEMENT
ION MANAGEMENT SCIENCE LAB

Theory-driven strategy simulation (TDSS): User manual*

SDA Bocconi - Ion Management Science Lab

* Version 1.0 .Prepared by Arnaldo Camuffo, Alfonso Gambardella, Saeid Kazemi and Mohammadmojtaba Nouri.

1. Introduction

Welcome to the Theory-Driven Strategy Simulation (TDSS) platform which allows you to learn and practice how to develop a theory of value for a business.

The theory-based approach to strategic decision making under uncertainty (Felin & Zenger, 2017, Camuffo, Gambardella & Pignataro, 2023) posits that strategists should envision future states (or, equivalently, formulate strategic problems (Baer et al., 2013) as causal conceptual structures characterized by a conscious belief. This represents a potential source of competitive advantage.

The TDSS platform allows players to practice, through case studies, the development of theories of value. Nudged by the narratives of world-famous case studies, players put themselves in the shoes of the founders or top executives and craft their theory of value simulating the strategists' process of reasoning, belief formation, testing and updating.

2. Analytic framework

Players learn to define, experiment with, and choose their theory of value according to the analytic framework developed by Camuffo, Gambardella & Pignataro (2023).

A theory of value is a system of ideas or concepts intended to explain, predict, or hypothesize the existence of a plausible and potentially valuable future state space. It is based on general principles, knowledge, and information independence of the state space whose existence is explained, predicted, or hypothesized.

A theory of value comprises three components:

a. Conceptual causal structure: number and type of conceptual elements (attributes) of the theory and the logical relationships that connect them.
b. Belief: subjective evaluation (probability) of how likely the future state space, explained by the theory, is to occur (conditional on being true, how likely the state space is to occur)
c. Prior on belief: subjective evaluation (probability) of to what extent the theory underlying the future state space is true (how confident the decision-maker is that the theory is not mis-specified)

Rationally, decision-makers try to develop and choose theories with high probabilities (strong beliefs and priors) as these correspond to future state spaces that are more plausible and potentially valuable.

Once decision-makers have defined their theory of value, they can experiment with it. Experimentation means gathering additional information about the attributes, the logical links of the theory and, hence, updating the belief and their prior on it.

However, if experimentation is costly, decision-makers should not experiment to test their theories, as the additional information the experiment provides does not bring, in expectation, any update on the belief and prior.

Nonetheless, if decision-makers develop alternative theories, it becomes worthwhile to conduct experiments on a theory, as decision-makers, in expectation, can benefit from the potential positive update deriving from the experiment while being safeguarded by the belief and prior of the alternative theory.

Decision makers should experiment with the theory with the higher variance, as it allows to conduct more surprising experiments. These experiments provide more additional information and, hence, a larger potential update on the belief and prior.

3. Simulations

At present, the TDSS platform comprises 30 simulations/case studies users can play with. These world-famous case studies cover a variety of industries and contexts.

Each case is built to immerse players in a strategic decision-making context characterized by uncertainty. They play the role of the founder or the CEO and learn a structured method to build a theory of value for the company. It is important to note that players do not simulate making decisions about specific strategic options or actions. Rather, they simulate how to develop, experiment with, and select their theory of value.

Each simulation comprises:

1. Background information about the company and decision-maker. Each simulation/case starts by providing background information about the company and the decision- maker (founder or CEO) that players identify with. It also describes the decision-making context, illustrating the future states the founder or top executive envisions.
2. Theories. For the six simulations/cases currently on the platform, the founders or top executives envision two different future state spaces and, hence, two different theories. Each theory comprises the following:
    a. A brief description which describes the conceptual elements of the theory (the "attributes" the decision makers consider), how they are logically connected (causal links"), the information available, as well as the line of reasoning, doubts, and beliefs).
    b. A "theory building ground" which nudges players to mimic the company founder's or CEO's theorizing process and construct their theory of value according to the following steps:
        - selection of what conceptual elements (attributes, variables or sub-problems) the decision-maker should consider (pay attention to);
        - logical connection of the attributes through causal links;
        - assignment of a belief (subjective probabilities) to the attributes and causal links
    c. the calculation of the subjective expected probability of the theory (how plausible or likely the decision-maker thinks it is, conditional on being true);
    d. the assignment of a prior to the belief (what is the subjective probability that the theory is true);
    e. the assignment of an expected probability if the theory is not true (what is the expected probability of the end state under all other imaginable alternative theories);
    f. the calculation of the expected value of the theory
3. Experiment. Players choose on which theory they want to experiment (collect additional information). The experiment provides additional information displayed by the simulation.
4. Theory update. Players are asked to update their theory (conceptual structure, belief, prior and expected probabilities), once again, using the "theory building ground".
5. Continued experimentation: Players can choose to continue experimenting with their theories and update them until they exhaust the value added potential of experimentation, relative to the time cost of continuing to experiment.

6. Theory choice. Finally, players are asked to choose which theory they want to ground their strategy on. Rationally, they should choose the theory for which their belief, weighted by their prior, is higher/stronger.

4. Rationale

Differently from traditional case studies or other simulations, there is no "right" or "wrong" solution. The outcomes of the simulations are subjective probability distributions (in the form of a parameter, its expected probability) which is the result of the players' reasoning. In the current version, the simulation backend provides the probability distributions (generated by an algorithm) which represent how likely the "true" theories and future state spaces are to occur.

The simulation produces these probabilities allowing players to get feedback about their theorizing.

Players compare the subjective expected probability of their selected theory with those generated by the simulation's backend algorithm.

This does not imply that the theory chosen by the player is right or wrong. It only implies that the theory the player believes is more likely to occur, might or might not be the one which is "actually" more likely to occur.

The player is therefore nudged to fully acknowledge and embrace the fundamental uncertainty of strategic decision-making.

5. Step-by-step guide to the simulations

Players start by registering to the TDSS platform. Once registered, they can log in and choose which simulations they want to play with. Simulations can be played as many times as player want. Indeed, repeated playing allows to better learn the theory building, experimenting and choosing framework, progressively refining the ability to formulate the strategic problem.

Ready to start?

Step #1: read the background information about the company and the founder or CEO at the beginning of the simulation.

Try to understand the decision context, empathize with the decision-maker and start reasoning

Step #2: Understand the future state space.

In each simulation, the decision-maker is trying to envision the future of its company and/or industry. Each simulation provides at least two alternative views of the future and two corresponding theories of value.

Step #3: Select Attributes.

Attributes are the elements of the problem the decision-makers consider, what they pay attention to, what they believe will affect and/or shape the future state space. In the current version of the simulations, they are binary random variables. They can be thought of as questions or sub-problems. Their uncertain realizations (the possible values of the random variable) can be thought of as the potential answers the players have in mind with regard to the questions underlying the attribute. The attributes in the simulations are all binary random variables that can take dichotomous values (e.g.: true, false: yes, no; high, low; good, bad; fast, slow). The simulations provide the attributes the decision-makers have in mind at the time of the decision. Players can decide to use some or all of them.

Step #4: causally connect the attributes.

Players build conceptual causal structures logically connecting the attributes. In the current version of the simulations, the conceptual structures are causal and can be represented as directed acyclic graphs which:

- contain only *directed* edges, do *not* contain any loop (edges from a node to itself) and do *not* contain any cycle (edges that start and end in the same node)
- one and only one node/attribute does not cause/imply any other node (this node represents the future state of interest to the decision-maker)
- at least one node/attribute is not caused/implied by any other node (this node represents an uncaused cause, a hypothesized event or action)

Step #5: assign subjective probabilities to attributes and causal links.

Based on their knowledge and experience, players assign subjective probabilities to attributes and causal links. Players do that to come up with the global probability distribution of their conceptual causal structure.

Step #6: calculate the expected probability of the theory (conditional on it being true)

This is automatically calculated once players have assigned their subjective probabilities to attributes and causal links. This is the player's belief on how likely to occur the future state of interest is, conditional upon the theory being true.

Step #7: assign a prior to the theory.

Players articulate how confident they are that their theory is true. This their subjective probability that the theory is not mis-specified.

Step #8: assign a subjective probability of occurrence to the state of interest if the theory is NOT true.

Step #9: calculate the expected probability of the theory weighted by the prior that it is true. This is automatically calculated based on steps #5, 6 and 7.

Please note that steps #3-9 must be done twice (two theories).

Step #10: decide whether to conduct an experiment or not and, if yes, on which theory.

Step #11: collect additional information from the experiment.

This is automatically provided in the form of a probability deriving from the experiment.

Step # 12: adjust the conceptual causal structure and update the subjective probabilities and prior.

Step #13: repeat experimenting on theories until the value added by experimentation becomes smaller than the temporal cost associated with the experiment.

This corresponds to repeating steps #10-12.

Step #14: choose a theory.

Players choose which theory they believe most plausible (future state space with the highest expected probability)

Step #15: calculation of "actual" future state spaces expected probabilities.

The simulation backend algorithm calculates automatically the "actual" future state spaces and probability distributions which represent how likely to occur the "true" theories and corresponding future state spaces are.

References

Baer, M., Dirks, K. T., & Nickerson, J. A. (2013). Microfoundations of Strategic Problem Formulation. *Strategic Management Journal*, 34(2), 197-214.

Camuffo, A., Gambardella, A., & Pignataro, A. (2023). Theory-Driven Strategic Management Decisions, CEPR Discussion paper n. 17664-2.

Felin, T., & Zenger, T. R. (2017). The theory-based view: Economic actors as theorists. *Strategy Science*, 2(4), 258-271.