

A NEW METHOD FOR MODELING INNOVATION AND R&D IN BUSINESS SIMULATIONS: ILLUSTRATED WITH A SIMULATION OF A NEW PRODUCT DEVELOPMENT PORTFOLIO

Gary Summers
Skillful Product Development
simsumm@verizon.net

ABSTRACT

Though appropriate for total enterprise simulations, the common method of modeling innovation and R&D in business simulations is not suitable for teaching the management of innovation and R&D. The common method is deficient because it simulates the outcome, but not the process, of R&D. This discussion paper presents a method that was proposed at ABSEL 1999: modeling innovation and R&D as a search of a technology space. This paper also presents the first simulation to use the new method. The simulation teaches R&D managers to manage a portfolio of new product development projects.

Technical innovation is a potent competitive force. It can raise a small firm to industry leadership or cause the fall of an industry giant. Even when its consequences are less dramatic, technical innovation is a perpetual concern of managers of high-tech companies. Every year scores of management books offer prescriptions, and every year companies of all sizes struggle to develop new technologies and create new products.

How do managers and executives learn to manage innovation and R&D? They learn on the job, and herein lays the problem. Several qualities of R&D hinder learning. Uncertainty is high. Years separate decisions from outcomes, and many factors affect results. People learn poorly in such situations, and the results are catastrophic. Instead of writing off mistakes as large, one-time educational expenses, high-tech companies pay for these mistakes again and again.

Seminars, conferences and knowledge of best practices are not a solution to this problem. Applying formal knowledge to work requires practice. In analogy, no medical student moves directly from *Gray's Anatomy* to surgery.

R&D executives and managers need business simulations so they can develop their skills in a risk free environment. Unfortunately, the common method of modeling innovation and R&D – probability functions – is insufficient for this task.

The common method of modeling innovation in educational business simulations has a student allocate capital to an R&D function, and this allocation purchases a draw from a probability distribution. If the draw exceeds a predetermined threshold, the firm innovates (Pray & Methé, 1991). The learner might make additional decisions that

affect the threshold or the probability distribution, such as staffing or the duration of the research. These decisions make the learner confront important aspects of R&D management. This method is useful in simulations where innovation and R&D play a peripheral role, such as total enterprise simulations (e.g., Capstone).

Unfortunately, the common method cannot teach the management of innovation. Neither can it teach the management of high-tech companies, where technological core competencies, technology-based competition and coordinating R&D with strategy are essential for success. Three qualities of the common method limit its usefulness. First, the method simulates the outcome of innovation but not the process of innovating. Second, the method reduces the management of innovation to an investment decision. Although investment is essential, innovation is a process of creating and exploiting knowledge. Any simulation of innovation must explicitly represent this process. Third, the common method poorly simulates technical advance. Technological advances create a multitude of opportunities and substantially increase uncertainty. The common method only simulates a small number of new opportunities, specified by predefined probability distributions.

The common method has a dominating precedent. Nearly all economic models that consider innovation use probability distributions. Is there another method?

Building upon research from complexity science, this discussion paper presents a new method for modeling innovation and R&D in business simulations (Summers, 2004). This method models innovation and R&D as a search through a technology space. The demonstration will proceed as follows:

Review of the common method: Exceeding the comments above, the common method will be described, and its benefits and limitations will be described.

The technology space method: The technology space method and its principal components will be introduced. The type of functions used with this method will also be illustrated.

Does the technology space method realistically simulate innovation? This question will be answered by demonstrating how the technology space method models technological advances, knowledge, innovation (incremental through major) and qualities of innovation, such as unpredictability, failure rates, path-dependency, surprise and probabilistic success.

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Analyzing students' decisions: Most simulations teach with an indirect method. Students try various strategies, observe the results, and hopefully, infer an improved understanding. The technology space model enables directed learning. With directed learning, the simulation analyzes students' judgments and decisions to discover their strengths, weaknesses, biases and errors. This analysis enhances feedback, debriefing and the simulation exercise to personalize the experience to each student's needs. The demonstration will describe this capability of the technology space method.

Examples: The demonstration will illustrate the versatility of the new method with examples of simulation architecture.

A simulation: The demonstration will present the first simulation using the technology space method. This simulation teaches students to manage a portfolio of new product development projects. The demonstration will present the architecture of the simulation, the students' decisions and the analysis of decisions. Components of the interface will be illustrated, and if possible, the demonstration will present results from the first use of the simulation.

REFERENCES

- Pray & Methé (1991) "Modeling radical changes in technology within strategy-oriented business simulations." *Simulation & Gaming*, Volume Twenty-Two, Number One, March 1991, 19-35.
- Summers (2004) Management Training Simulation Method and System. US Patent Application, publication forthcoming.