Chapter 2
Optimization: The Enemy of Innovation

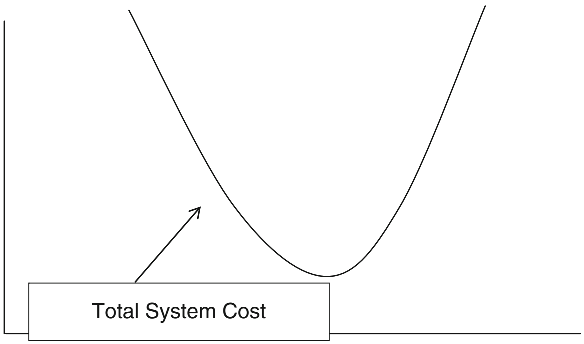
How many times have you seen a graph like the one in Fig. 2.1?

What does it imply to you? You can't have it all, it says. These thoughts occur to you even without labeling either axis or describing the system we are talking about. We see this kind of graph so often that we don't realize that there are at least two lines on this graph condensed into one curve. There is some function, attribute, or characteristic that is improving, while another one is getting worse and the graph in Fig. 2.1 is the net sum of the two, showing the "optimal" point in the system. In my days as a chemical engineer, and in the training I do for the American Institute of Chemical Engineers, this curve is commonplace in training and analysis when describing many chemical process unit operations. The more insulation you put on a pipeline, the less heat you lose, but the cost of the insulation (as well as its installation and maintenance cost) increases. There is an "optimum" insulation thickness that is a function of the cost of energy and the cost of insulation and labor at a given point in time. When a process plant is built, the design engineer, with possible input from long range planning thinking about the price of energy, calculates the cost of the energy required to keep a process pipe at a certain temperature versus the cost of the thickness of the insulation materials (or the tracing system if steam or hot oil is used). This is exactly the same calculation and thought that goes into the decision about how much insulation is installed into a home. The cost of the insulation system is prorated over the projected life of the process plant, taxes and depreciation are figured in, and a graph such as the one is produced (Fig. 2.2).

Chemical and mechanical engineers who specialize in this area have numerous computer programs and algorithms which can optimize this design, taking into account insulation costs and the cost of energy in different forms (steam, electric, hot oil). Every once in a while, possibly triggered by a significant increase in the cost of energy, a review of these decisions is made and the possibility of changing the type or thickness of the insulation is made, using the same kind of cost–benefit trade off analysis. In this discussion, we have *assumed* that we needed the insulation. It's easy to fall into that trap, isn't it? We have a system that we have had for a long time. It's not perfect and we slowly but surely try to optimize it based on all

J. Hipple, *The Ideal Result: What It Is and How to Achieve It*,
DOI 10.1007/978-1-4614-3707-9_2,

Fig. 2.1 Classical optimization curve



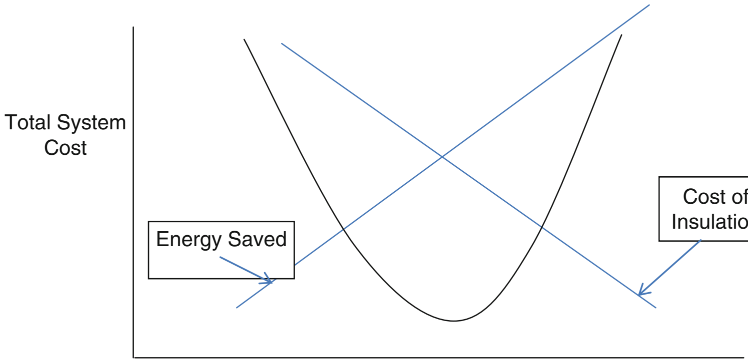


Fig. 2.2 Optimization of insulation

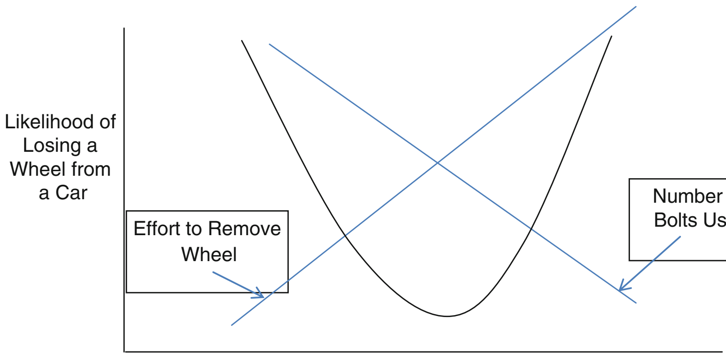


Fig. 2.3 Wheel loss optimization

kinds of external conditions. Optimizing like this means balancing two negative things, which surely does not produce an Ideal Result.

Let's take a look at another similar example that everyone is familiar with—the tire and wheel on a car. A graph similar to the heat transfer optimization graph would look like the one in Fig. 2.3.

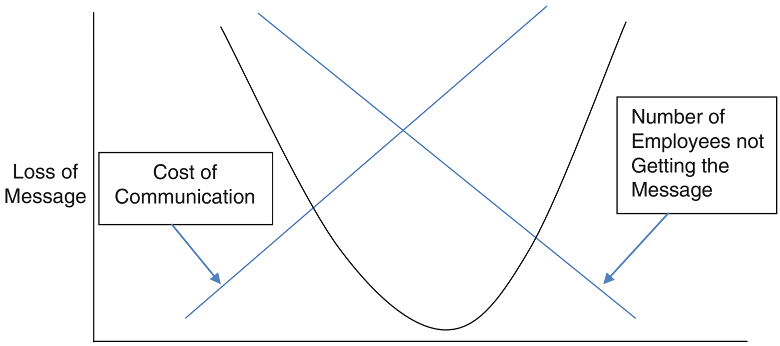


Fig. 2.4 Optimization of organizational communication

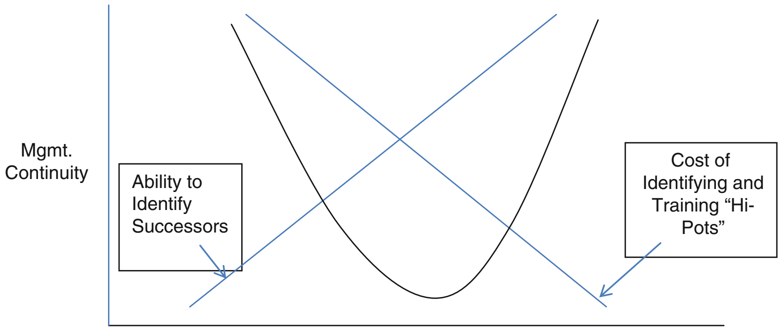


Fig. 2.5 Optimization of organizational succession planning

Over the years, the tire, wheel, and auto companies have “optimized” the choice of the number of bolts to minimize the pain while minimizing the chance the wheel will fall off. Is this really an Ideal Result? What if we didn’t have to tighten any bolts at all? (Hold that thought!).

What does a graph summarizing internal organizational communication as shown in Fig. 2.4?

We can’t afford to tell everyone everything, can we? So we make a judgment call about how much information is needed by whom and rely on our managers to communicate “down the line” as they see fit, potentially filtering the information from getting to everyone who might need or be interested in it. We also make choices about which mechanisms we use to communicate—written materials, bulletin boards, Emails, and other electronic forms of communication (Fig. 2.4).

What about succession planning in an organization? The graph might be the one in Fig. 2.5:

“Hi-pots” is a term used in many companies to designate young “up and comers,” thought to be candidates for senior management positions.

What are the other business examples of this type of analysis? As an organization becomes larger, communication becomes an issue. Many companies have a

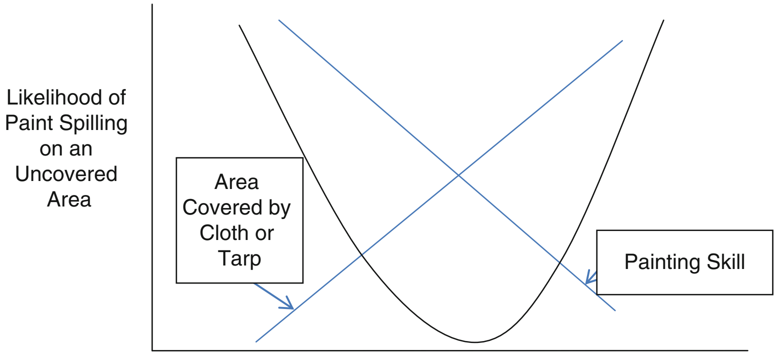


Fig. 2.6 Optimization of floor covering while painting

deliberate policy of not allowing site sizes to grow beyond a certain level. This maximizes the efficiency of communication within a site and starts to inhibit communication between sites. One problem gets easier and another becomes more of a challenge. We have a tradeoff that we think must be managed and "optimized."

Consider communication with customers. How much is too much? How do we decide how often to touch base with a current customer and "see how they're doing?" Do we wait for a complaint? How much travel money needs to be spent communicating? Are there alternatives? Is the optimization the same for all customers? Is the solution the same? What affects these decisions? This is analogous to the decision about how much insulation is needed when the cost of energy changes. The thought process is the same.

Let's look at painting. When you are upon a ladder with a roller pan and paint roller, you don't want to get paint on the floor. You make a judgment call about how clumsy you are and decide how much and how thick and what type of drop cloth you are going to use. Here's the graph that went through your head without realizing it (Fig. 2.6).

What if we didn't have to worry about the paint spilling and did not need a tarp or cloth? (Hold that thought too!).

Back to chemical engineering. In a distillation column, we trade off the number of trays and the reflux ration in the column as in Fig. 2.7.

The more trays we put in a distillation column, the less reflux (material returned to the column) is needed and the lower the energy cost to reboil the liquid up into the column. The capital cost of the column now increases. If we shorten the column, we need more energy to produce the same separation. Large amounts of time and money are spent on this optimization in the oil and petrochemical area to minimize the total cost of producing gasoline, heating oil, and a myriad of petrochemicals such as ethylene, propylene, and styrene—the backbone materials of our hydrocarbon, fuel, and plastics industries.

If we consider the business analogy to this example, consider the pricing of chemicals and materials versus their purity. Some people will pay more for 99.99 % purity, others will not. For them, 99 % may be just fine. What does this optimization

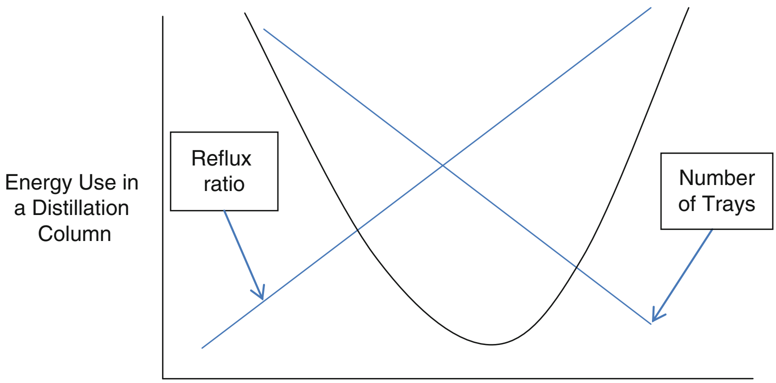


Fig. 2.7 Optimizing a distillation column

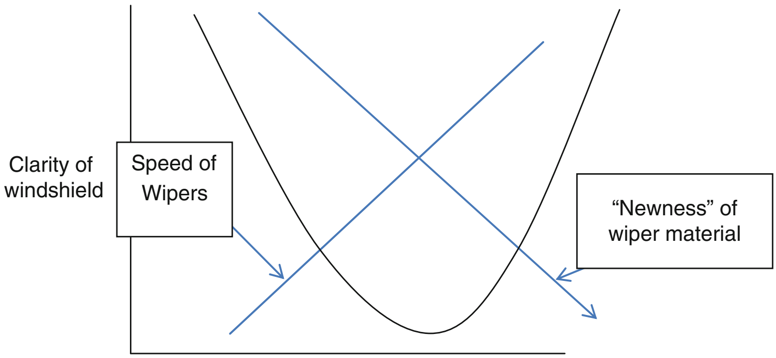


Fig. 2.8 Optimization of windshield wiper speed

curve look like? If we put our TRIZ hat on for a short while, we might begin to ask how we might change how a lower purity material can match the performance of a higher purity material. Why do we have to move back and forth along the curve? How can we move the curve?

Consider the windshield wiper speed in your car during a rainstorm (Fig. 2.8).

The more frequently we sweep the windshield, the more rain is removed and the clearer our vision. However, this wears the blades and leads to their earlier replacement. What if we didn't need wipers at all? Have you seen the Rain-X® product?

We have the issue of protecting children from getting into medicine bottles, while at the same time making the bottles easy to open for people with arthritis (Fig. 2.9).

This is an example of a design contradiction that has significant social implications. No one wants to a see a small child poisoned by medication, but at the same time we don't want to see the elderly not take their medicine because they cannot open the bottle. Why do we need the cap? Why do we need the bottle? Is swallowing a pill the only possible way of delivering medication? Is that the only way to

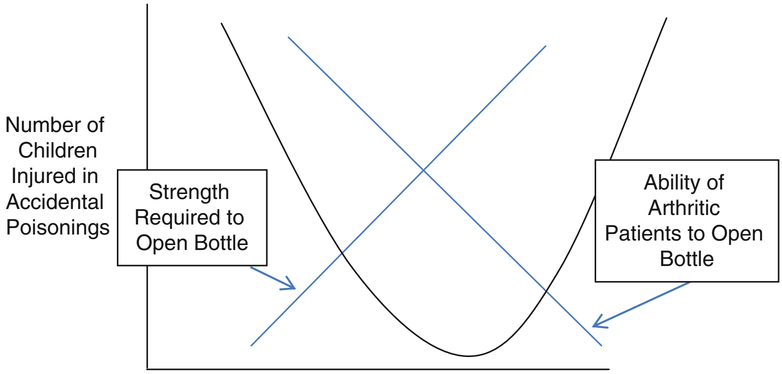


Fig. 2.9 Optimization of pill bottle design

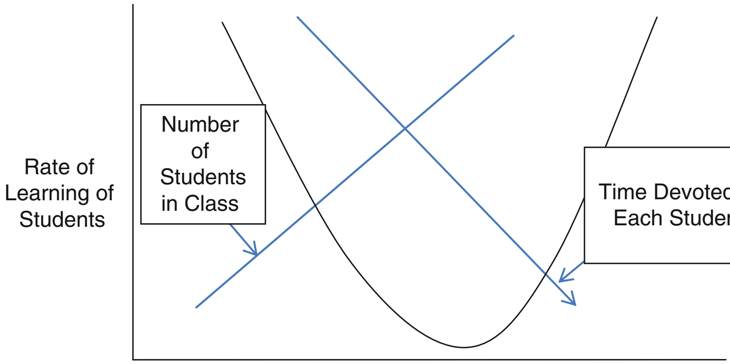


Fig. 2.10 Classroom optimization

dispense medicines? What other ways are there to dispense medicines in a way that prevents any accidental exposure to young children? Is there a way to prevent children from opening the bottle? What is fundamentally different about children's physical traits and adult traits that eliminate the potential danger to a child opening a bottle? Let's not minimize the potential danger—let's *eliminate* it!

Other examples we could plot might be the optimization of chemical reaction, temperature balancing rate, and yield for an exothermic chemical reaction or the manner in which we administer a merit increase or bonus program (how do we motivate our best people without demotivating our "average" performers?).

Let's look at the classical contradiction graph that is constantly discussed by teachers, parents, teacher unions, and boards of education (Fig. 2.10).

Many parents, teachers, and teachers unions believe that classroom size is a key determinant in learning. This may be true in some circumstances, but there are many examples where this is not true and some other factor may be more important. If we plot performance against only one variable, we may not see the whole picture.

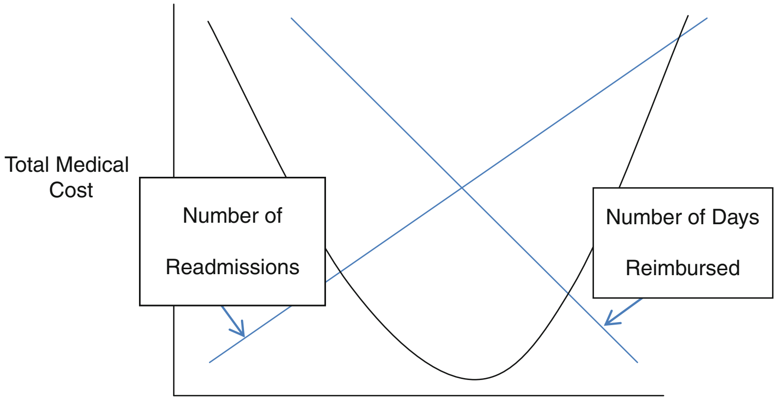


Fig. 2.11 Insurance optimization

Table 2.1 Optimization table

This gets better	This gets worse	Optimization control variable(s)

Might nutrition, family life, teacher competence, or learning materials have an equal effect? We don't know and a graph as seen in Fig. 2.10 can deceive us.

Let's take a look at one last optimization graph, representing how a medical insurance company decides how long to reimburse the patient and hospital for planned surgery or pregnancy (Fig. 2.11)?

If we send mothers with newborns home in less than 48 h, we minimize the immediate cost of the stay and reimbursement, but run the risk of a significant readmission cost should a complication arise. Is "optimizing" the stay time the best way to handle this?

I could go on and on with dozens of additional examples, but you get the point. You can do the same thing for your technology, process, social, or organizational issue. Make a list of the compromising issues you face (and make sure you include both business and organizational issues in the list!) (Table 2.1).

Keep these thoughts in mind when we discuss contradictions in Chap. 10.

If you appreciate graphical representations, take these tradeoffs and make graphs similar to the ones I showed earlier. A template is included in the appendix for your use (See Fig. 2.12).

We tend to think of the world as a choice between good and bad, resulting in a decision to minimize the pain as determined by some arbitrary definition. In areas of morality and religion, the concepts of good and bad may be perfectly acceptable, but in the real world of designing and operating equipment and processes or in the world of organizational management, things are never this black and white. The "optimum" may also be different for different stakeholders in the above cases. Surely the maker of wheel bolts does not see the wheel situation the same way as

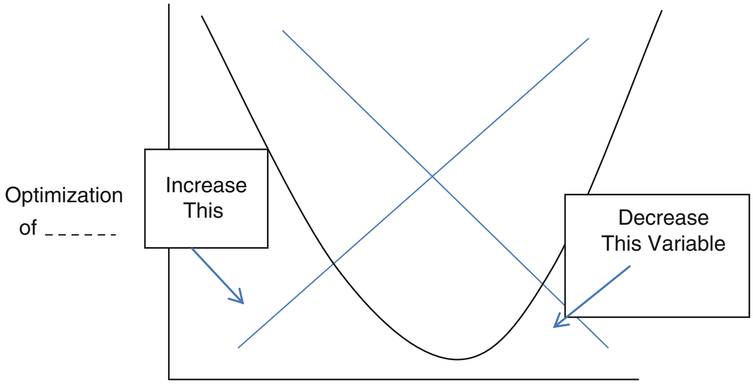


Fig. 2.12 Optimization template

the auto driver who must remove the wheel. The supplier of paint tarps does not see things the same way as the homeowner who would like to find a way not to use tarps at all. The maker of distillation column trays does not see things the same way as an external utility supplying the steam. In our current discussions about improving health care and its delivery, the trial lawyers, insurance companies, hospital administrators, sick patients, doctors, and nurses all have different visions of the "optimum" goal and the way to achieve it.

In thinking about our current health care debate in the USA, do the patient, the nurse, the doctor, the hospital, and the medical insurance company look at things the same way? Certainly not. What would their graphs look like? What variables might these other professions plot on such a graph?

The point here is that the optimization of a system and the Ideal Result (which we will discuss in a later chapter) is not necessarily the same as viewed by all stakeholders. The tools of TRIZ do not provide a direct answer to this choice, but some of its tools can point the direction we should look to make the best choice. We'll discuss this in more detail later.

Now, having thought about "optimizing" for a while, ask yourself—are you happy with this approach? You may have minimized the pain, but it's still there. We may have moved the pain to somewhere else in the system. It's like taking a sleeping pill every night to compensate for too much caffeine or paying some of your deductible housing expenses to minimize taxes this year—which increases the taxes due next year. When you do this, are you really "innovating" or just optimizing and compromising? You are working within the constraints of the system *as it exists!* Now of course, if a product or system has not been analyzed and optimized in a long time, the result may appear to be an "innovation" and is certainly worth doing and may have significant cost savings, but as long as we are trading off, I submit we are only improving and not innovating. We are operating and analyzing within the framework of what we know and already do. There is nothing wrong with going after the low-hanging fruit, but do not let this activity distract you from attacking longer term, more permanent solutions.

This brings us to a couple of the fundamental principles within the TRIZ tool kit and algorithm. The first of these is the concept of the Ideal Result. Those of you who are into optimizing, try to imagine what life would be like if the issue or parameter that needs to be optimized simply disappeared as an issue of concern. (By the way, this is no problem for a child with some imagination, as they do not know all the reasons you can't do something!) Imagine there is no reason to do succession planning, no need to constantly update the computer program that calculates the optimum reflux ration, and no need to worry about the wheel falling off the car. Don't you feel better already? Outsourcing is one thing that corporations do to get rid of this pain and hassle, especially if they believe their competence in a particular area is weak. But again, we still have only minimized the pain and put it out of sight.

Let's relook at some of the previous examples. In the first case, the pipe insulation—what if there was no insulation thickness to optimize? Now I don't mean that the material inside the pipe freezes or boils and we just live with that result and call the necessary maintenance people when we need them. I mean that the material in the pipe and other components in the system *other* than insulation *control their own temperature*. Or maybe we use a fluid whose physical properties make it less likely to freeze or boil. Just think about that while we look at case 2—the wheel. What if there were no wheel bolts? There's nothing to optimize because the bolts are gone and the wheel still stays on. In the communication example, what if we had no communication meetings to plan, organize, and optimize? How much money would that save? In succession planning, what if we spent no time analyzing and vetting future leaders? What if they just appeared when we needed them? A lot of time and money would be saved.

In the painting example, what if we had no pan that might spill, no roller that might sloop and leak? We wouldn't need a big tarp! In the distillation column, we are balancing capital and energy costs. What if we did not have to separate the materials in the first place? No steam, no column. Why can't the car window stay clean without wiper blades? Then there's nothing to adjust. The window cleans *itself.* Finally, in the case of the pill bottle, if the lid goes away, there's no force or system to optimize. How can pills be stored and delivered for adults in a way that doesn't require a bottle the size kids want to play with? What if the cap and bottle geometry were such that it was impossible for a child to open, but easy for someone with arthritis to open?

Do you see what we are starting to do here? We are getting out of the optimization mind set and getting to a type of root cause thinking, but far beyond normal root cause thinking. If we *get rid of the problem* (the thing or variable we are trying to optimize), then there's nothing to optimize—there is no problem we need to solve. How much money is that worth? The problem and the system become simpler because we eliminate something. *Anything* that is eliminated from a system makes it simpler, costs less, requires less maintenance and attention, and improves reliability. It's easy to conceptually eliminate a part of the system. The challenge is to follow that thought with a serious, methodical methodology that figures out how to eliminate a part or system and still achieve the result or function that it was originally put there to do. That's what the rest of this book is all about. But I want to emphasize that without the desire and capability to make this fundamental mind shift, the rest of what you will read will probably be interesting (like a fairy tale you enjoy) but not relevant or useful. So spend some serious time reorienting your brain and thinking about the Ideal Result. Stop optimizing, trading off, and minimizing pain. Let's get rid of the pain and stop taking pain relievers.

Exercises

1. Take a product or service you provide or use and seriously think about the tradeoffs which have occurred, over time, in performance, operability, user friendliness, or other key parameters. Make a simple, qualitative graph if you can. How have these tradeoff decisions been made? On what basis? Why? What has been the cost of the "fix" versus the perceived cost savings? Has the root cause of the problem ever been identified? Eliminated? Why or why not?
2. What is the key variable that is used to control the optimization? If you don't know, why not? Is there more than one? What is its function? Is that function *really* needed? Why? If the function is really needed, how else could it be achieved?
3. Has your optimization graph changed over time? Why? What caused the change? If you don't know, ask yourself why and find out.
4. What is your rationale for "optimizing?" Does it really make sense? Why? On what basis?
5. Who drew the optimization graph? How many views of this graph might there be? Do others use the same "*y*" and "*x*" variables? Why or why not? Is there a variable that some see as important and other don't? Why? What are the implications of different optimization graphs?

Use the optimization template (Fig. 2.12 and also in the appendix) to assist you in doing this.

Springer

http://www.springer.com/978-1-4614-3706-2

The Ideal Result
What It Is and How to Achieve It
Hipple, J.
2012, XVI, 192 p. 56 illus., 32 illus. in color. With online files/update., Softcover
ISBN: 978-1-4614-3706-2